

LPU-2428 & RST-4001

User Manual

Table of Contents

Introduction	iii
Warranty and Warranty Restrictions	iv
Chapter 1: Specifications and Options.....	1
Dimensions	1
Specifications	2
Chapter 2: Installation and Removal Procedures and Notes.....	3
Tools Needed.....	3
Installation Notes	3
Mounting Instructions	4
Electrical Installation	4
Software Installation.....	5
Removal Instructions	5
Chapter 3: Maintenance	5
General Care	5
Troubleshooting	6
Calibration	6-7
Repair and Returns.....	7
Chapter 4: Programming and Parameter Configuration	7
RST-4001 User Interface	7
RST-4001 Menu Navigation	8-11
Software User Interface.....	12
Programming the LPU-2428	13
Basic Setup Menu (BASICSET)	14-15
App. Setup Menu (APPLICAT).....	16-34
4-20 Setup Menu (4-20 SET).....	34-36
Calibration (CALIBRAT)	36-37
Advanced (ADVANCED)	37-39
Utilities (UTILITIE).....	39-40
Totalization (TOTALIZE).....	41
Chapter 5: Hazardous Location Drawing and Certification	42
Intrinsically Safe Wiring Diagram	42
Hazardous Location Wiring Diagram	43
CSA Certificate of Compliance	44-47

i IMPORTANT: The LPU-2428 software will only operate in a 32-bit Windows environment. It WILL NOT operate on a 64-bit Windows machine.

Introduction

Thank you for purchasing an LPU-2428 ultrasonic sensor and RST-4001 programming module from APG. We appreciate your business! Please take a few minutes to familiarize yourself with your LPU-2428, RST-4001, and this manual.

The LPU-2428 loop-powered ultrasonic sensor provides a low-power, non-contact level measurement solution rated for hazardous locations and suitable for harsh chemical environments. The RST-4001 offers a two-line by eight-character LCD display and five-button keypad or USB connection for programming your sensor.

The default Application setting for the LPU-2428 is Distance, which will work in a wide variety of settings. The LPU-2428 has several additional Application settings that can be configured to meet your needs.

Reading your label

Every APG instrument comes with a label that includes the instrument's model number, part number, serial number, and a wiring pinout table. Please ensure that the part number and pinout table on your label match your order. The following electrical ratings and approvals are also listed on the label. Please refer to the Certificate of Compliance at the back of this manual for further details.

Electrical ratings



Input: 12 to 28 Volts DC; Output: 4-20mA

Class I Division 1; Groups C, D T3

Class I, Zone 0, Group IIB

AEx ia IIB T3 (USA): Ta: -40°C to 60°C; IP65

Ex ia IIB T3 (Canada): Ta: -40°C to 60°C; IP65

V_{max} U_i = 28VDC, I_{max} I_i = 130mA, P_{max} P_i = 0.91W, C_i = 0nF, L_i = 110μH

Install in accordance with drawing 9002747 (page 42).



Input: 12 to 28 Volts DC; Output: 4-20mA

Class I Division 2; Groups C, D T6

Class I, Zone 2, Group IIB

AEx nA IIB T6: Ta: -40°C to 60°C; IP65

Ex nA IIB T6: Ta: -40°C to +60°C; IP65

Install in accordance with drawing 9002745 (page 43).

i IMPORTANT: Your LPU-2428 MUST be installed according to drawing 9002747 as indicated above to meet Intrinsically Safe approvals. Faulty installation will invalidate all safety approvals and ratings.

Warranty and Warranty Restrictions

APG warrants its products to be free from defects of material and workmanship and will, without charge, replace or repair any equipment found defective upon inspection at its factory, provided the equipment has been returned, transportation prepaid, within 24 months from date of shipment from factory.

THE FOREGOING WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES NOT EXPRESSLY SET FORTH HEREIN, WHETHER EXPRESSED OR IMPLIED BY OPERATION OF LAW OR OTHERWISE INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

No representation or warranty, express or implied, made by any sales representative, distributor, or other agent or representative of APG which is not specifically set forth herein shall be binding upon APG. APG shall not be liable for any incidental or consequential damages, losses or expenses directly or indirectly arising from the sale, handling, improper application or use of the goods or from any other cause relating thereto and APG's liability hereunder, in any case, is expressly limited to the repair or replacement (at APG's option) of goods.

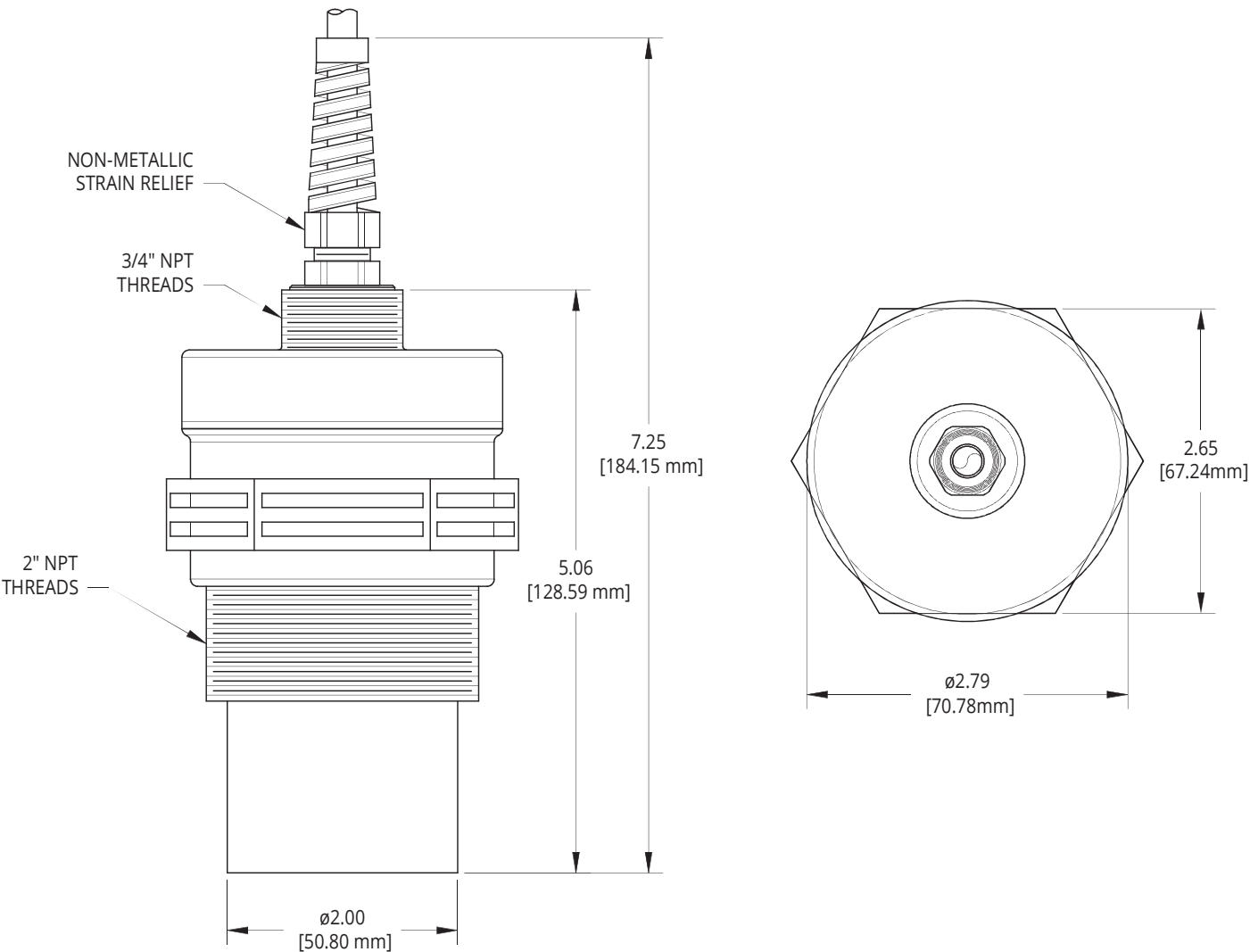
Warranty is specifically at the factory. Any on site service will be provided at the sole expense of the Purchaser at standard field service rates.

All associated equipment must be protected by properly rated electronic/electrical protection devices. APG shall not be liable for any damage due to improper engineering or installation by the Purchaser or third parties. Proper installation, operation and maintenance of the product becomes the responsibility of the user upon receipt of the product.

Returns and allowances must be authorized by APG in advance. APG will assign a Return Material Authorization (RMA) number which must appear on all related papers and the outside of the shipping carton. All returns are subject to the final review by APG. Returns are subject to restocking charges as determined by APG's "Credit Return Policy".

Chapter 1: Specifications and Options

- Dimensions



• Specifications

Performance

Operating Range	1 - 25 ft. (0.3 - 7.6 m) on liquids and hard, flat surfaces 1 - 10 ft. (0.3 - 3 m) on bulk solids
Analog Output (Sensor)	4-20 mA
Analog Output (Module)	USB
Beam Pattern	9° off axis
Frequency	69 kHz
Response Time	0.6 - 3 seconds (dependent on output range)
Sample Rate	3 seconds @ 4 mA 0.6 seconds @ 20 mA

Accuracy

Accuracy	±0.25% of detected range
Resolution	0.1 inch (2.54 mm)

Environmental

Operating Temperature	-40 to 60°C (-40 to 140°F)
Internal Temperature Compensation	Yes
Enclosure Protection	IP65
NEMA rating (Sensor)	4X

Electrical

Supply Voltage (at sensor)	12-28 VDC
Current Draw	22 mA max
Output Signal	3-30 mA max
Load Resistance	150Ω max @ 12 VDC 600Ω max @ 24 VDC
Cable Connection (Sensor)	2-wire cable included
Cable Connection (Module)	2-terminal Phoenix connector, USB

Materials of Construction

Transducer Housing	PVDF (Kynar®)
Upper Housing (Sensor)	PC/PBT
Housing (Module)	ABS PA-756

Chapter 2: Installation and Removal Procedures and Notes

• Tools Needed

Tools are not necessary for installing the LPU itself. If you are using a stand pipe to mount your LPU, you will probably need tools to install the stand pipe, but not for the LPU.

• Installation Notes

- Mount your LPU sensor so that it has a clear, perpendicular sound path to the surface being monitored. Your sensor should be mounted away from tank or vessel walls and inlets. See Figure 2.1.
- The sound path should be free from obstructions and as open as possible for the 9° off axis beam pattern.
- If you are using a stand pipe, please see our guide to stand pipes on our website:
<http://www.apgsensors.com/about-us/blog/how-to-install-a-stand-pipe>.

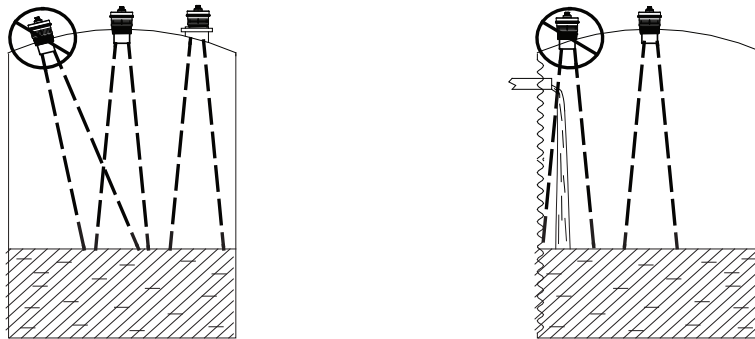



Figure 2.1

 **NOTE:** Do not mount the sensor where the beam will intersect objects such as fill streams, pipes, ladder rungs, wall seams, or corrugated tank walls.

• Mounting Instructions

Mounting your LPU is easy if you follow a few simple steps:

- Never over-tighten the sensor.
- Always screw in your sensor by hand to avoid cross-threading. Thread failure can be a problem if you damage threads by over-tightening them or by crossing threads.

i IMPORTANT: Do not over tighten! The sensor should be threaded in only hand tight.

• Electrical Installation

For normal operation, connect the provided cable to your control system:

- Connect the red wire to +24 VDC.
- Connect the black wire to 4-20 mA input. Circuit load resistance + input resistance must be greater than 150Ω. 249Ω is recommended for optimal signal transmission.
- Refer to drawing 9002747 (page 42) for Intrinsically Safe installation.
- Refer to drawing 9002745 (page 43) for hazardous location installation.

For programming:

- Connect (+) terminal of RST-4001 to +24 VDC supply of sensor (red wire).
- Connect (-) terminal of RST-4001 to 4-20 mA signal from sensor (black wire).
- Ensure that load resistor is between RST-4001 and control network or PLC, rather than between sensor and RST-4001. (See Figure 2.2)

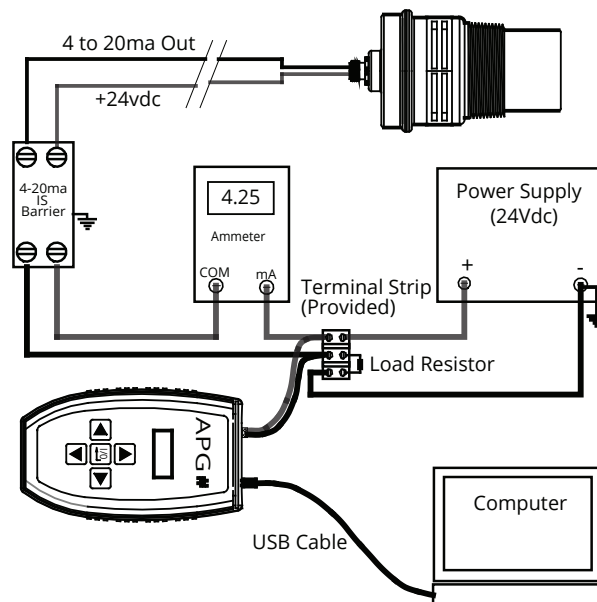


Figure 2.2

- **Software Installation**

- Download the software zip file from <http://apgsensors.com/support>.
- Open the zip file.
- Choose "Install" from the options at the top of the zip file window.
- The installation process will prompt you as needed to complete the installation.
- The software will create and run from a folder in your start menu titled "APG".

i IMPORTANT: The LPU-2428 software will only operate in a 32-bit Windows environment. It WILL NOT operate on a 64-bit Windows machine.

- **Removal Instructions**

- Ensure that power to the sensor is off.
- Disconnect the cable from the sensor.
- Remove the sensor and store it in a dry place, at a temperature between -40° F and 180° F.
- If the sensor was installed in a hazardous location, ensure that the cable will not be energized while the sensor is disconnected.

⚠ DANGER: Do not disconnect equipment installed in hazardous locations unless power has been switched off or area is known to be non-hazardous.

Chapter 3: Maintenance

- **General Care**

Your LPU-2428 ultrasonic sensor is very low maintenance and will need little care as long as it was installed correctly. However, in general, you should:

- Avoid applications for which the sensor was not designed, such as extreme temperatures, contact with incompatible corrosive chemicals and fumes, or other damaging environments.
- Inspect the threads whenever you remove the sensor from duty or change its location.

• Trouble Shooting

Should you have problems with your LPU-2428, here are some troubleshooting steps.

- Check the received signal strength (just to left of the three Help buttons in the lower right corner. See Figure 4.32). If the signal strength is low, alternately increase Pulses and Sensitivity (Figure 4.30) until the signal strength improves.
- Ensure Temperature Compensation (Figure 4.30) is turned on.
- Set the Gain Control to AutoSense (Figure 4.30).
- Ensure that Blanking (Figure 4.30) is accurately set to account for any unwanted targets between the sensor and the closest acceptable target.
- Ensure that the LPU-2428 software is installed in a 32-bit Windows environment. Although the software will install in a 64-bit environment, it will not operate.

i **IMPORTANT:** The LPU-2428 software will only operate in a 32-bit Windows environment. It WILL NOT operate on a 64-bit Windows machine.

• Calibration

This procedure uses targets at known distances to calibrate the sensor's accuracy. A wall or other large, flat object is recommended for the long range target.

- Point the sensor at a target at a known distance near the maximum range of the sensor, 25' for a single solid object (See Figure 3.1).
- Adjust the Multiplier value until the distance reading on the sensor matches the actual measured distance to the target (See Figure 4.29).
- Point the sensor at a target near the minimum measurement range, 1' plus any Blanking distance (See Figure 3.2).
- Adjust the Offset value until the distance reading on the sensor matches the actual measured distance to the target (See Figure 4.29).
- Repeat previous two steps until no further adjustment is required.

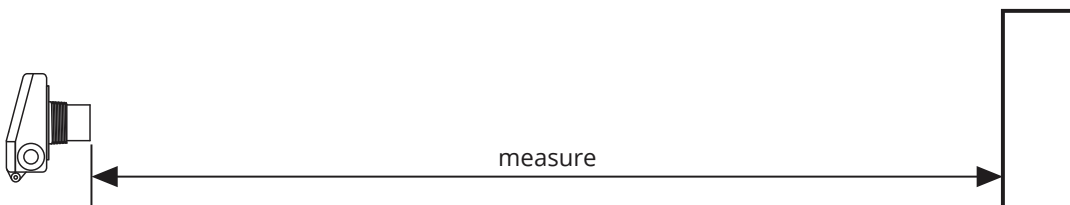


Figure 3.1

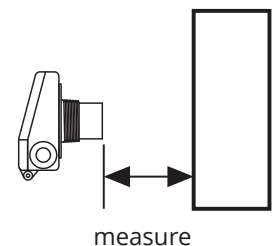


Figure 3.2

 **NOTE:** The Reset parameter in the Utilities Menu (Figure 4.31) will reset the LPU-2428 to factory default settings.

• **Repair and Returns**

Should your LPU-2428 ultrasonic sensor require service, please contact the factory via phone, email, or online chat. We will issue you a Return Material Authorization (RMA) number with instructions.

- Phone: 888-525-7300
- Email: sales@apgsensors.com
- Online chat at www.apgsensors.com

Please have your LPU-2428's part number and serial number available. See Warranty and Warranty Restrictions for more information.

Chapter 4: Programming and Parameter Configuration

• **RST-4001 User Interface**

The RST-4001 user interface is made up of a two-line by eight-character LCD screen and five buttons. (See Figure 4.1)

The LCD display shows the current measurement (Distance is the default Application setting). The display is also used to navigate menus, and view and edit parameters when programming. Menus appear on the top line in ALL CAPS. Parameters cycle on the bottom line with Initial Caps. Parameter values are shown on the top line, and are numeric values or ALL CAPS.

The LPU has five programming or navigation buttons, LEFT Arrow, RIGHT Arrow, UP Arrow, DOWN Arrow, and I/O (Enter). The arrow buttons allow the user to move through the menus in order to access and change parameters. Pressing the I/O button saves the displayed value of a parameter.



Figure 4.1

• RST-4001 Menu Navigation

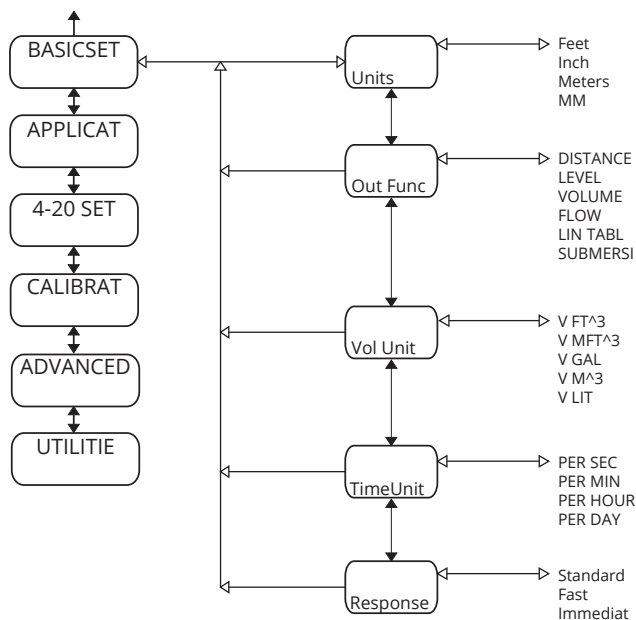
To select a menu, press the UP Arrow or DOWN Arrow button until the desired menu is displayed. Press the Right arrow to move into that menu. Then press the UP or DOWN Arrow button to move to the desired parameter.

To view or change a parameter value, press the RIGHT Arrow button. The display will show the name of this parameter on the lower line and the current value on the upper line of the display. To change the parameter's value, press the UP Arrow or DOWN Arrow button until the desired value is displayed.

To store or save the changed value, press the I/O button once. At this point, the parameter value has been saved to the LPU. The values are stored in nonvolatile memory, and will not be lost when power is turned off.

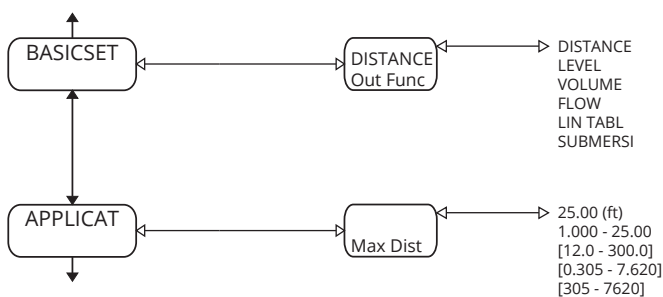
For a full explanation of each menu and parameter, see pages 13 - 41.

Main Menus and BASICSET Menu

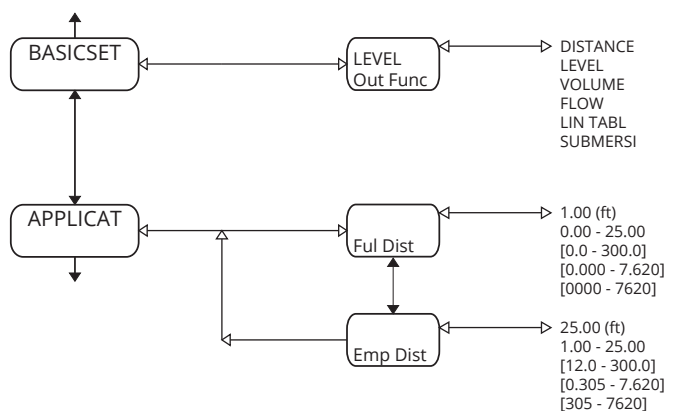


NOTE: Menu options change dynamically based on selected Out Func. See menu explanations on page 15.

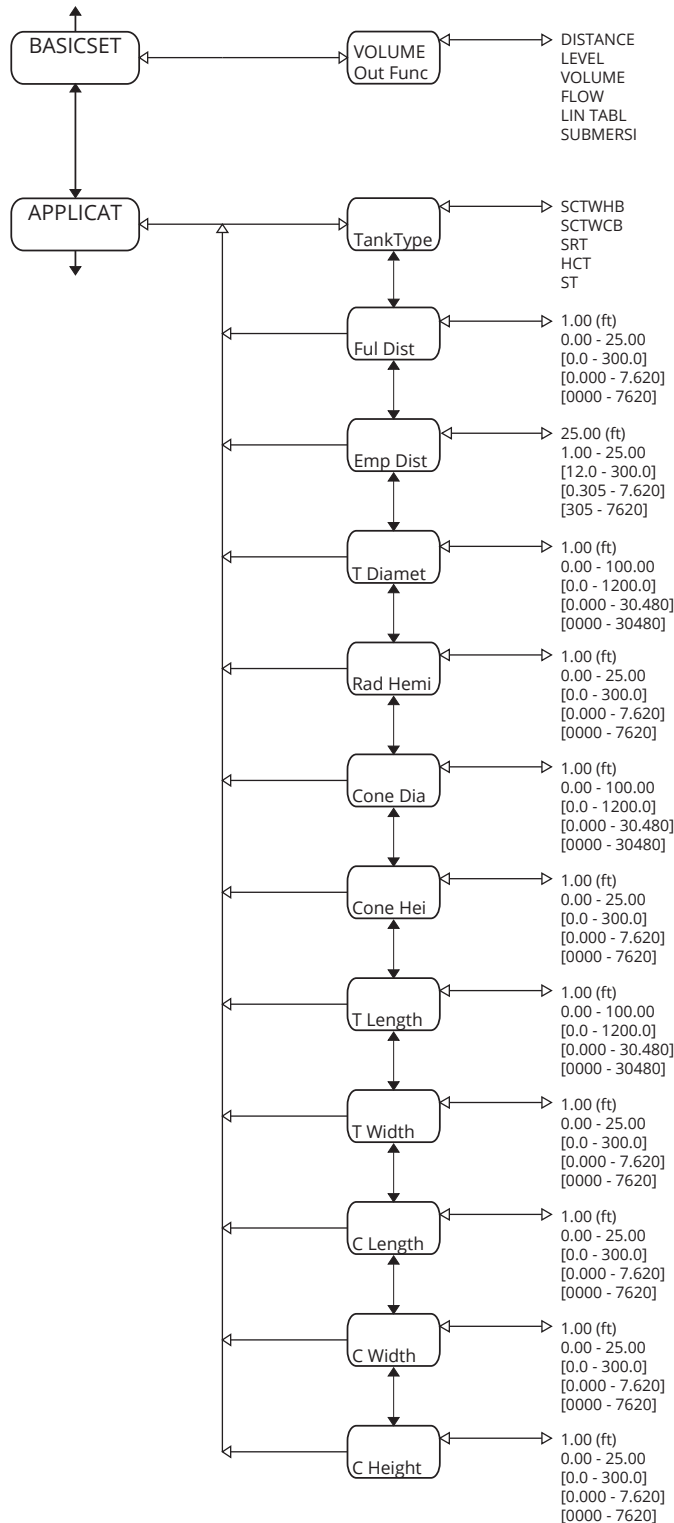
Distance APPLICAT Menu



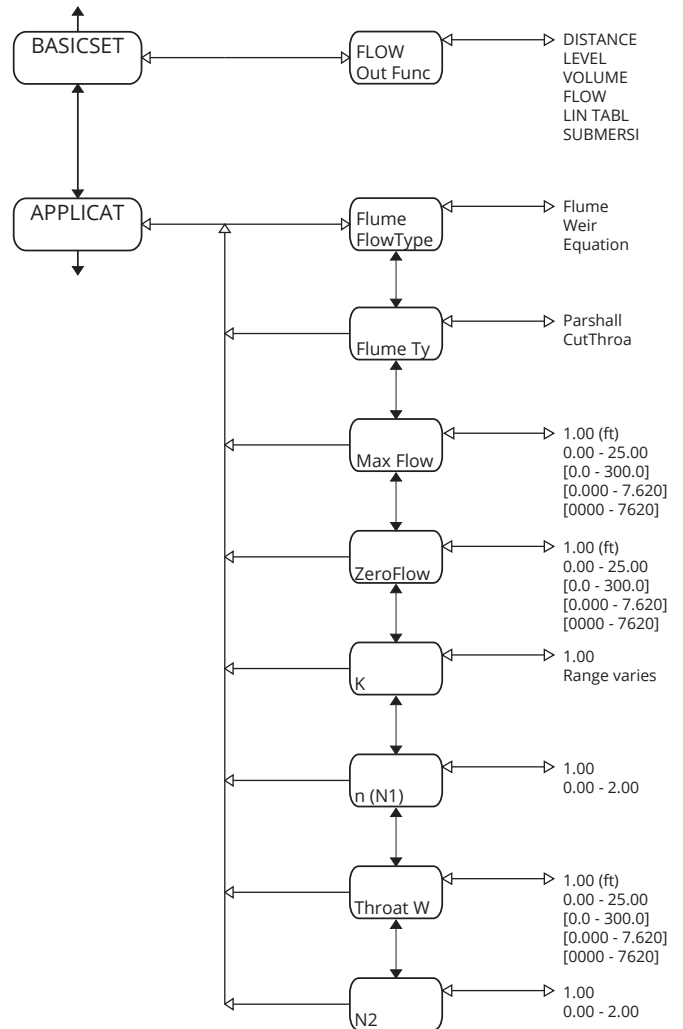
Level APPLICAT Menu



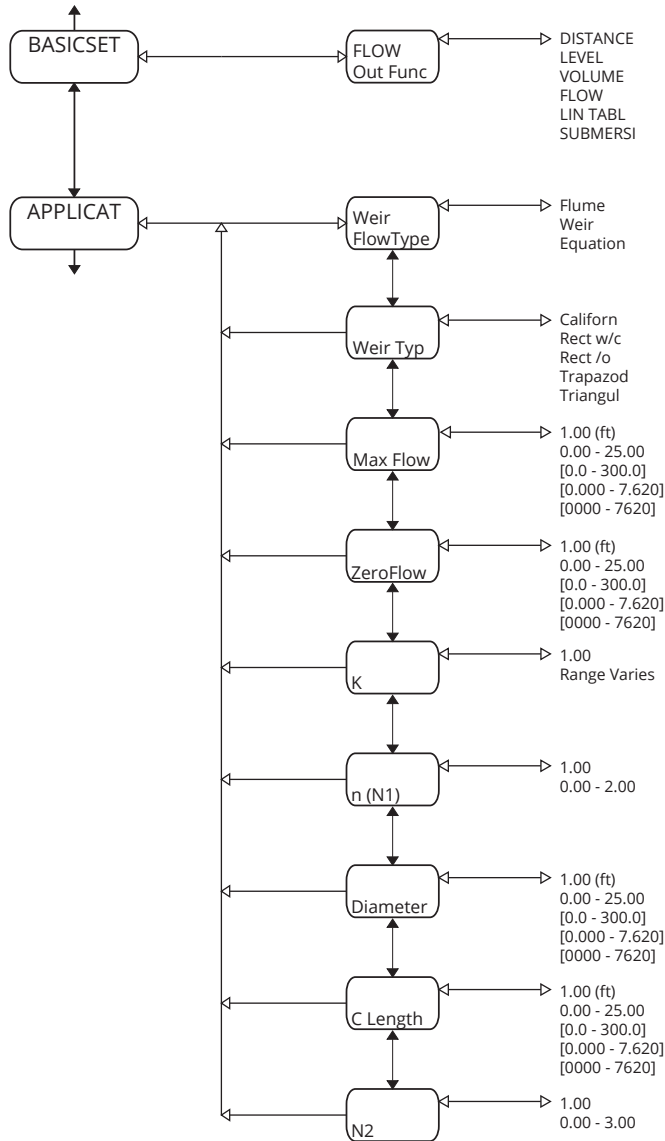
Volume APPLICAT Menu



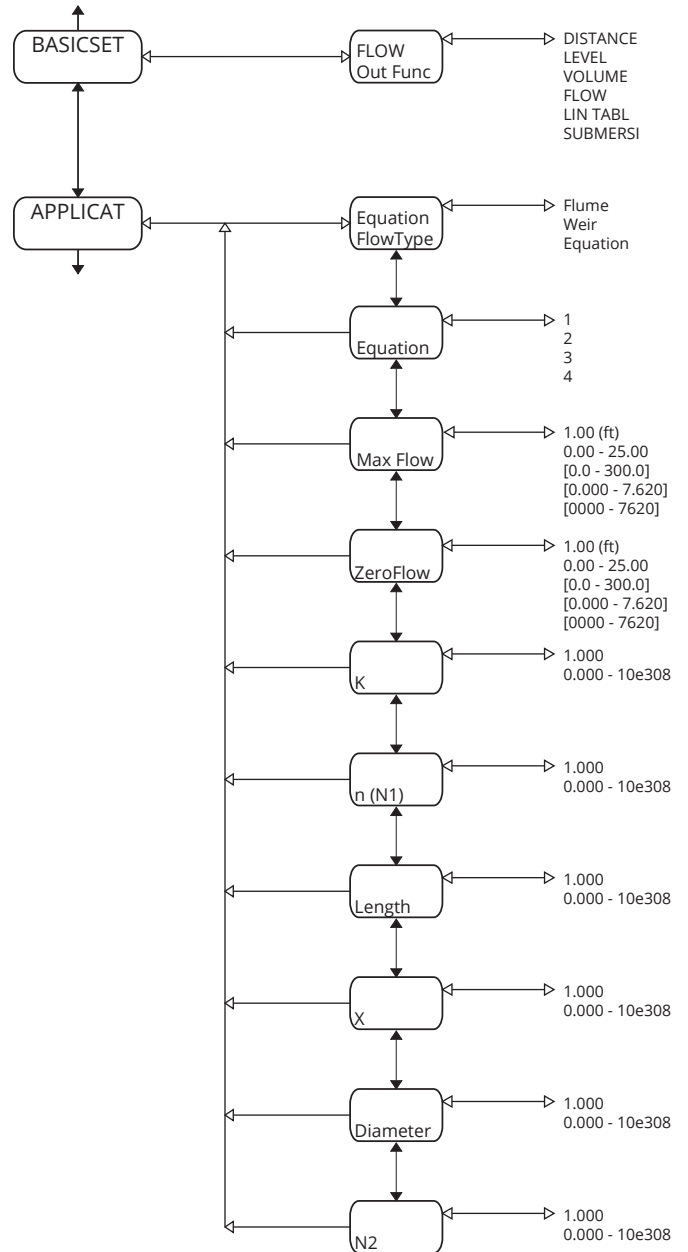
Flow - Flume APPLICAT Menu



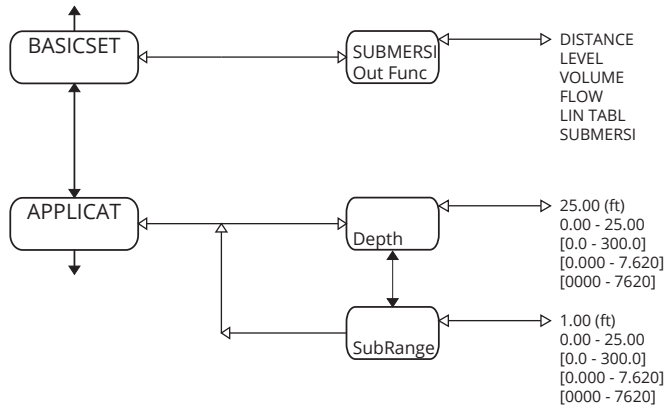
Flow - Weir APPLICAT Menu



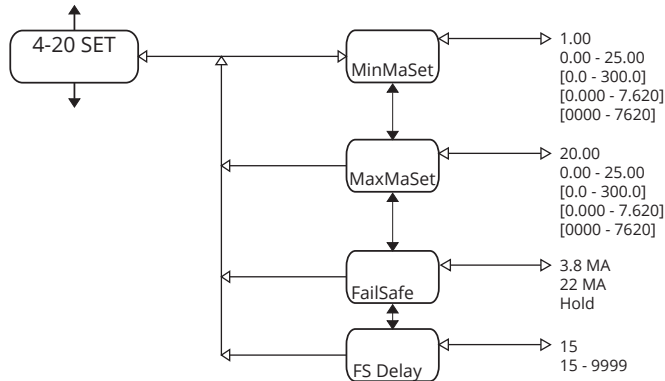
Flow - Equation APPLICAT Menu



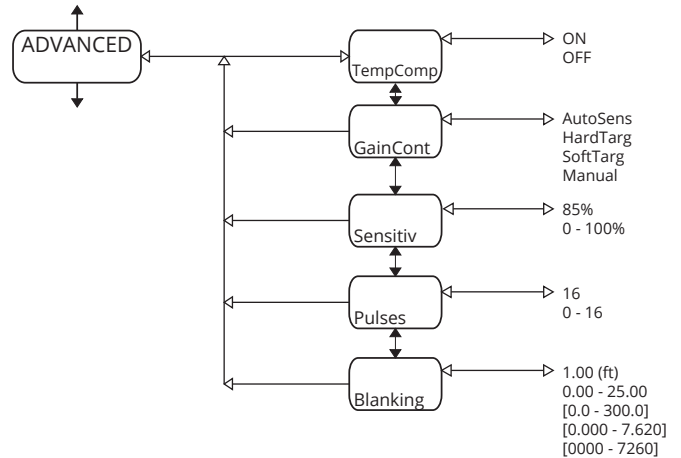
Submersible APPLICAT Menu



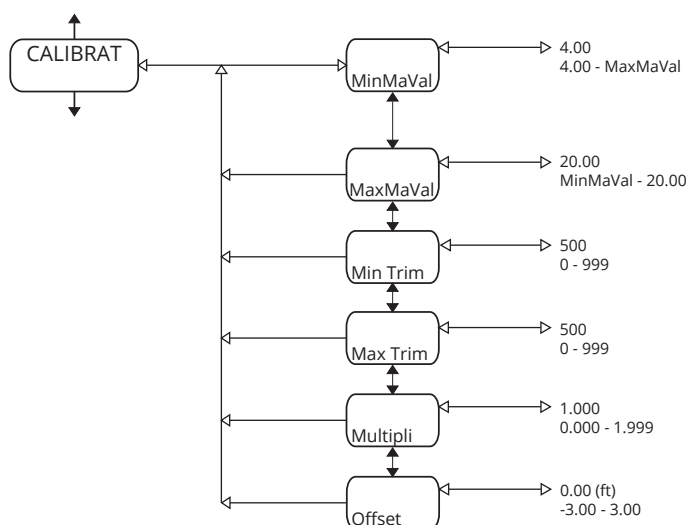
4-20 SET Menu



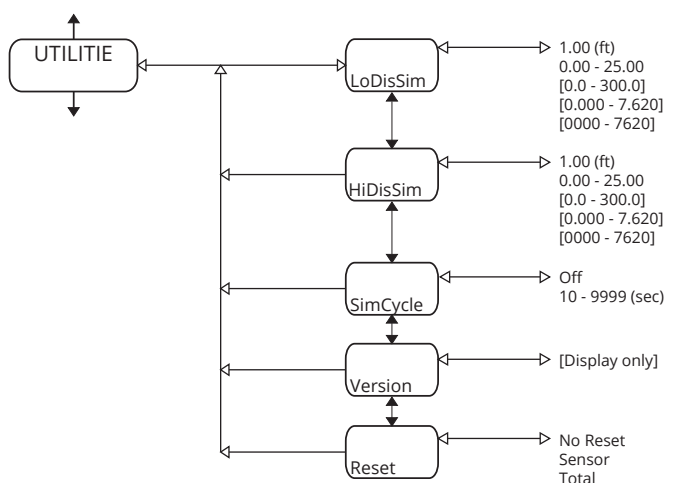
ADVANCED Menu



CALIBRAT Menu



UTILITIE Menu



- **Software User Interface**

The LPU-2428 software user interface is one screen with five primary areas (See Figure 4.2). In the upper left are seven Menu Buttons. These buttons control the information viewed in the Display Area. Below the Menu Buttons and Display Area are six Status Boxes in two columns. Under the right hand column of Status Boxes are three Control Buttons. Three Help Buttons are located in the lower right hand corner of the screen.

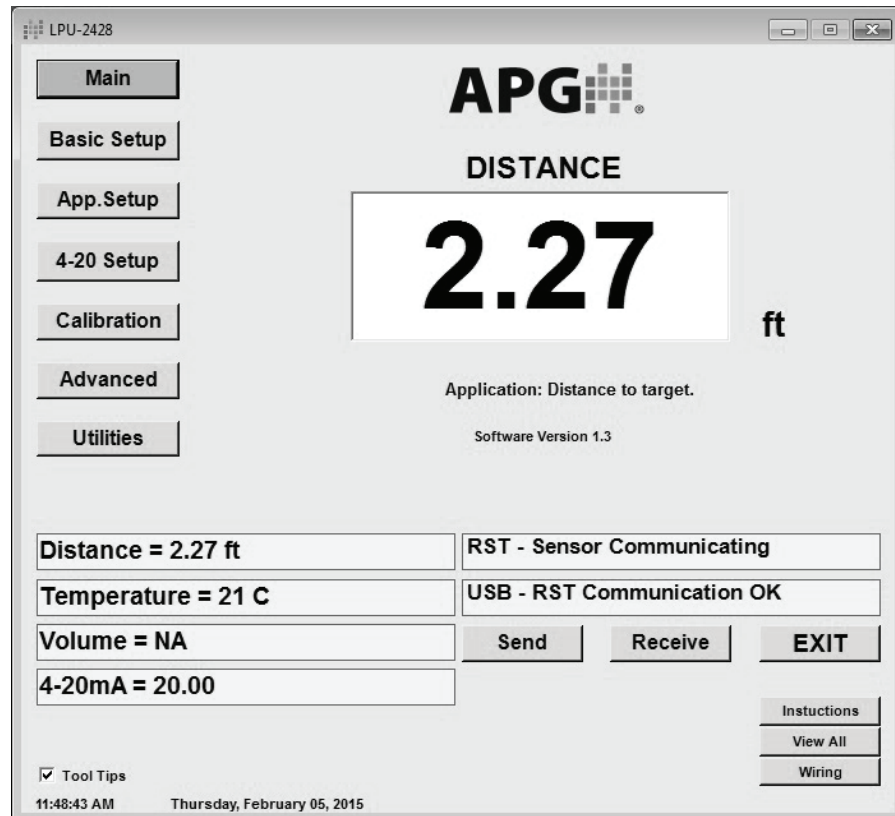


Figure 4.2

The two Status Boxes in the right column show the status of communication between the RST-4001 and the sensor, and between the LPU-2429 software and the RST-4001 (See Figure 4.3).

If an error is indicated, then check for proper connections. Allow a moment for the communication to be established while watching the status box to indicate "Sensor Communicating". If this fails to establish communication, plug the USB cable into another USB port on the computer. After communication is established, click on the "Receive" button to load the sensor settings into the software.

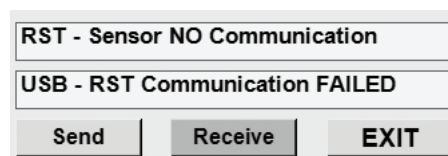


Figure 4.3

- **Programming the LPU-2428**

The following menus are used to program the LPU-2428 whether you use the RST-4001 alone, or in conjunction with the LPU-2428 software. As described in the RST-4001 User Interface section above, menus are navigated on the RST-4001 using the UP Arrow and DOWN Arrow, and selected with the RIGHT Arrow. In the LPU-2427 software, menus are navigated by clicking on the desired Menu Buttons on the left side of the screen.

Main:

Displays distance, level, volume, or flow. A graphical representation is displayed for level, volume, or flow.

Basic Setup:

Menu contains Units, Application, Flow/Volume Units, Flow Rate, and Response Time.

App. Setup:

Menu contains parameters specific to the current Application selected in Basic Setup. These include Volume Tank Type, Flow Type, Max/Full Distance, Zero/Empty Distance, and values for flow or volume.

4-20 Setup:

Menu contains Min & Max mA Setpoints, Fail Safe, and Fail Safe Delay.

Calibration (not required on most applications):

Menu contains Min & Max mA Value, Min & Max mA Trim, Multiplier, and Offset.

Advanced:

Menu contains Temperature Compensation, Gain Control, Sensitivity, Pulses, and Blanking.

Utilities:

Menu contains Low & High Distance Simulation, Simulation Cycle Time, Reset, File System, and Software Version.

- **Basic Setup Menu (BASICSET)**

Figure 4.4

Menu	Parameter	RST-4001 Options	Software Options
Basic Setup	<i>Units</i> (Units)	Default = Feet	Default = Feet
		Feet	Feet
		Inch	Inches
		Meters	Meters
		MM	Millimeters

Units (*Units* on the RST-4001) selects the units of measurement that will be used throughout the setup process and also for display. The selected units also determines the resolution of the display and the outputs. The resolution is: feet 0.01, inches 0.1, 0.000 meters, and millimeters 1.

NOTE: All parameter settings use the units selected in *Units*.

Menu	Parameter	RST-4001 Options	Software Options
Basic	<i>Application</i>	Default = DISTANCE	Default = Distance
Setup	<i>(Out Func)</i>	DISTANCE	Distance
		LEVEL	Level
		VOLUME	Volume
		FLOW	Flow
		LIN TABL	Linearization Table
		SUBMERSI	Submersible

Application (*Out Func* on the RST-4001) selects the measurement function of LPU-2428. Parameters for each application are configured in the App. Setup (APPLICAT) menu (See Figure 4.5). The selected application is displayed on the Main Screen under the measurement (See Figure 4.2).

Menu	Parameter	RST-4001 Options	Software Options
Basic	<i>Volume Units</i>	Default = V FT^3	Default = Cubic Feet
Setup	<i>(Vol Unit)</i>	V FT^3	Cubic Feet
		V MFT^3	Million Cubic Feet
		V GAL	Gallons
		V M^3	Cubic Meters
		V LIT	Liters

Volume Units (*Vol Unit* on the RST-4001) selects the units for volume measurement. *Vol Unit* is only displayed on the RST-4001 when *Out Func* is set to VOLUME or FLOW. Similarly, *Volume Units* is greyed out in the LPU-2428 software unless *Application* is set to Volume or Flow.

Menu	Parameter	RST-4001 Options	Software Options
Basic	<i>Flow Rate</i>	Default = PER SEC	Default = Per Minute
Setup	<i>(TimeUnit)</i>	PER SEC	Per Second
		PER MIN	Per Minute
		PER HOUR	Per Hour
		PER DAY	Per Day

Flow Rate (*TimeUnit* on the RST-4001) selects the units for flow rate measurement. *TimeUnit* is only displayed on the RST-4001 when *Out Func* is set to FLOW. Similarly, *Volume Units* is greyed out in the LPU-2428 software unless *Application* is set to Flow.

Menu	Parameter	RST-4001 Options	Software Options
Basic	<i>Response Time</i>	Default = Standard	Default = Standard
Setup	<i>(Response)</i>	Standard	Standard
		Fast	Fast
		Immediat	Immediate

Response Time (*Response* on the RST-4001) selects the desired response time of the LPU-2428. The response time represents the maximum rate of change in target level that the sensor will accurately display. A faster response time correlates to a less stable output.

- **App. Setup Menu (APPLICAT)**

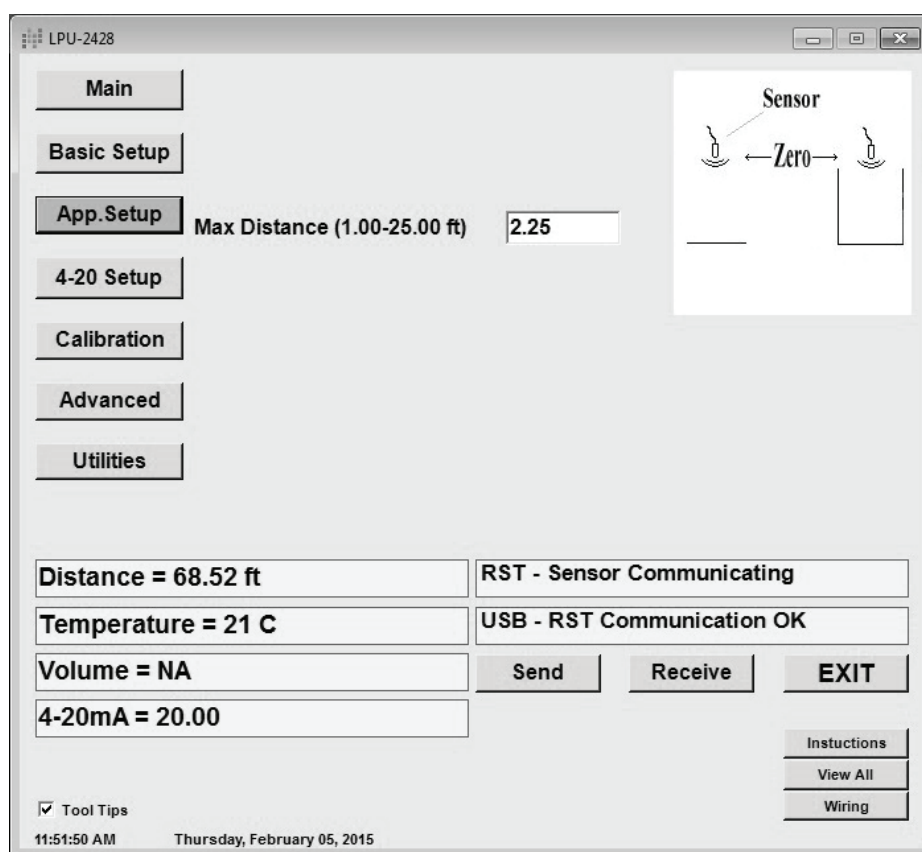


Figure 4.5

App/Out

Func	Parameter	RST-4001 Options	Software Options
Distance	<i>Max Distance</i> (<i>Max Dist</i>)	Default = 25.00 (ft)	Default = 25.00 Feet
		1.00 - 25.00 Feet	1.00 - 25.00 Feet
		12.0 - 300.0 Inch	12.0 - 300.0 Inches
		0.305 - 7.620 Meters	0.305 - 7.620 Meters
		305 - 7620 MM	305 - 7620 Millimeters

Max Distance (*Max Dist* on the RST-4001) sets the maximum operating range for the LPU-2428. 25 feet is the physical limit of the LPU-2428. (See Figure 4.5)

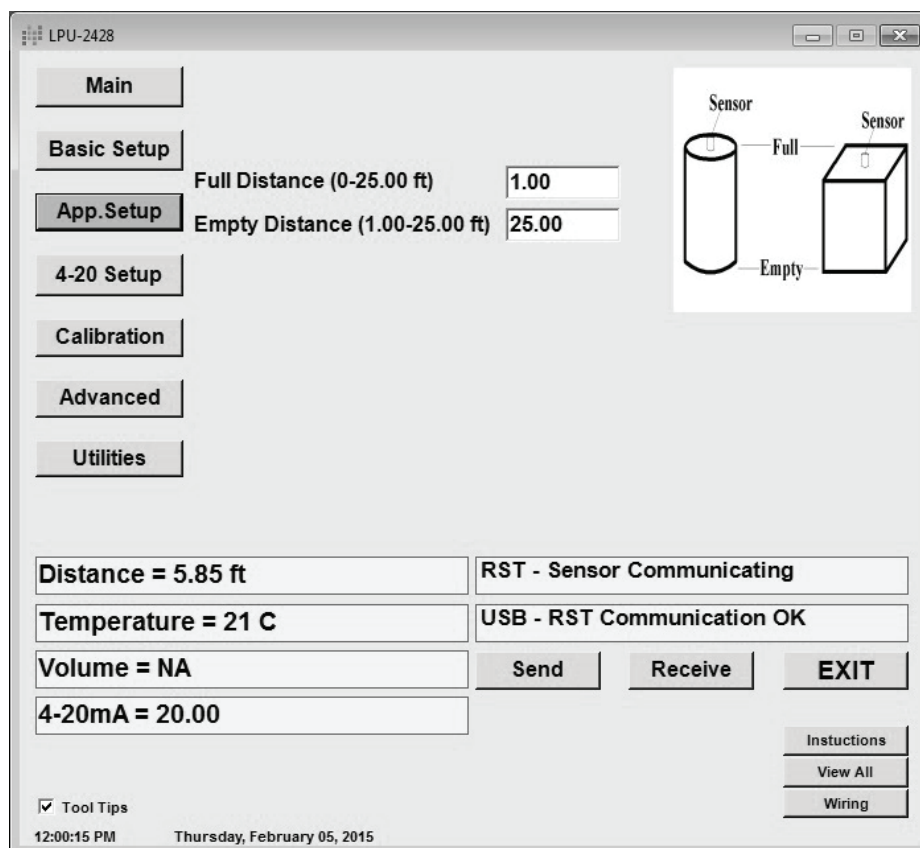


Figure 4.6

App/Out

Func	Parameter	RST-4001 Options	Software Options
Level	<i>Full Distance</i> (<i>Ful Dist</i>)	Default = 1.00 (ft) 0.00 - 25.00 Feet 0.0 - 300.0 Inch 0.000 - 7.620 Meters 000 - 7620 MM	Default = 1.00 Feet 0.00 - 25.00 Feet 00.0 - 300.0 Inches 0.000 - 7.620 Meters 000 - 7620 Millimeters

Full Distance (*Ful Dist* on the RST-4001) sets the distance from the sensor to the full level of the vessel being monitored. (See Figure 4.6)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Level	<i>Empty Distance</i> (<i>Emp Dist</i>)	Default = 25.00 (ft) 1.00 - 25.00 Feet 12.0 - 300.0 Inch 0.305 - 7.620 Meters 305 - 7620 MM	Default = 25.00 Feet 1.00 - 25.00 Feet 12.0 - 300.0 Inches 0.305 - 7.620 Meters 305 - 7620 Millimeters

Empty Distance (*Emp Dist* on the RST-4001) sets the distance from the sensor to the empty level of the vessel being monitored. (See Figure 4.6)

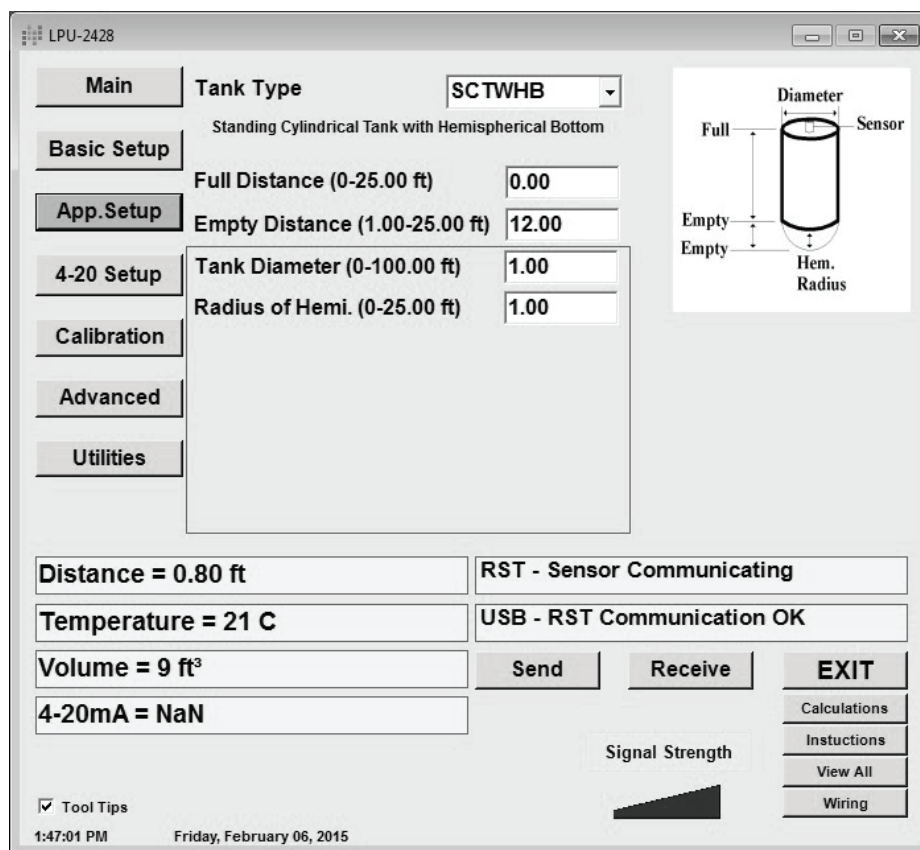


Figure 4.7

App/Out

Func	Parameter	RST-4001 Options	Software Options
Volume	<i>Tank Type</i> (<i>TankType</i>)	Default = SCTWHB SCTWCB SRT HCT ST	Default = SCTWHB SCTWCB SRT HCT ST

Tank Type (*Tank Type* on the RST-4001) selects the general geometry of the tank. (See Figures 4.7-4.11)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Volume	<i>Full Distance</i> (<i>Ful Dist</i>)	Default = 1.00 (ft) 0.00 - 25.00 Feet 0.0 - 300.0 Inch 0.000 - 7.620 Meters 000 - 7620 MM	Default = 1.00 Feet 0.00 - 25.00 Feet 00.0 - 300.0 Inches 0.000 - 7.620 Meters 000 - 7620 Millimeters

Full Distance (*Ful Dist* on the RST-4001) sets the distance from the sensor to the full level of the tank being monitored. (See Figures 4.7-4.11)

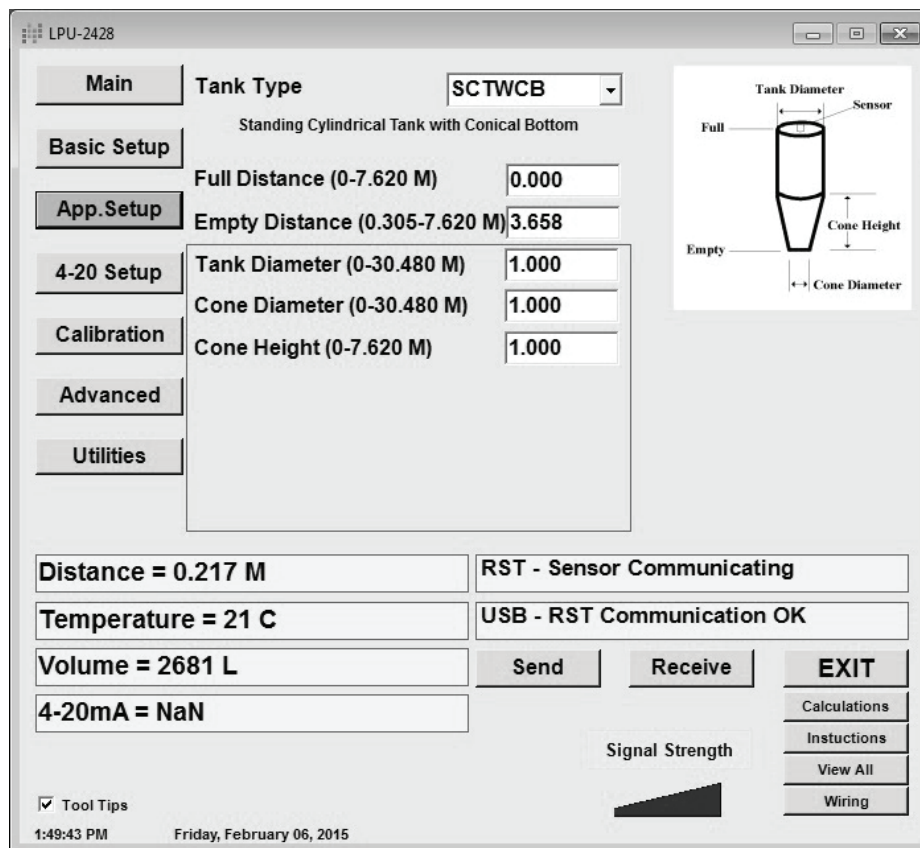


Figure 4.8

App/Out

Func	Parameter	RST-4001 Options	Software Options
Volume	Empty Distance (Emp Dist)	Default = 25.00 (ft) 1.00 - 25.00 Feet 12.0 - 300.0 Inch 0.305 - 7.620 Meters 305 - 7620 MM	Default = 25.00 Feet 1.00 - 25.00 Feet 12.0 - 300.0 Inches 0.305 - 7.620 Meters 305 - 7620 Millimeters

Empty Distance (Emp Dist on the RST-4001) sets the distance from the sensor to the empty level of the tank being monitored. (See Figures 4.7-4.11)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Volume	Tank Diameter	Default = 1.00	Default = 1.00
SCTWHB	(T Diamet)	0.00 - 100.00 Feet	0.00 - 100.00 Feet
SCTWCB		0.0 - 1200.0 Inch	00.0 - 1200.0 Inches
HCT		0.000 - 30.480 Meters	0.000 - 30.480 Meters
ST		000 - 30480 MM	000 - 30480 Millimeters

Tank Diameter (T Diamet on the RST-4001) sets the diameter of cylindrical (SCTWHB, SCTWCB, HCT) or spherical (ST) tank. (See Figures 4.7, 4.8, 4.10, and 4.11)

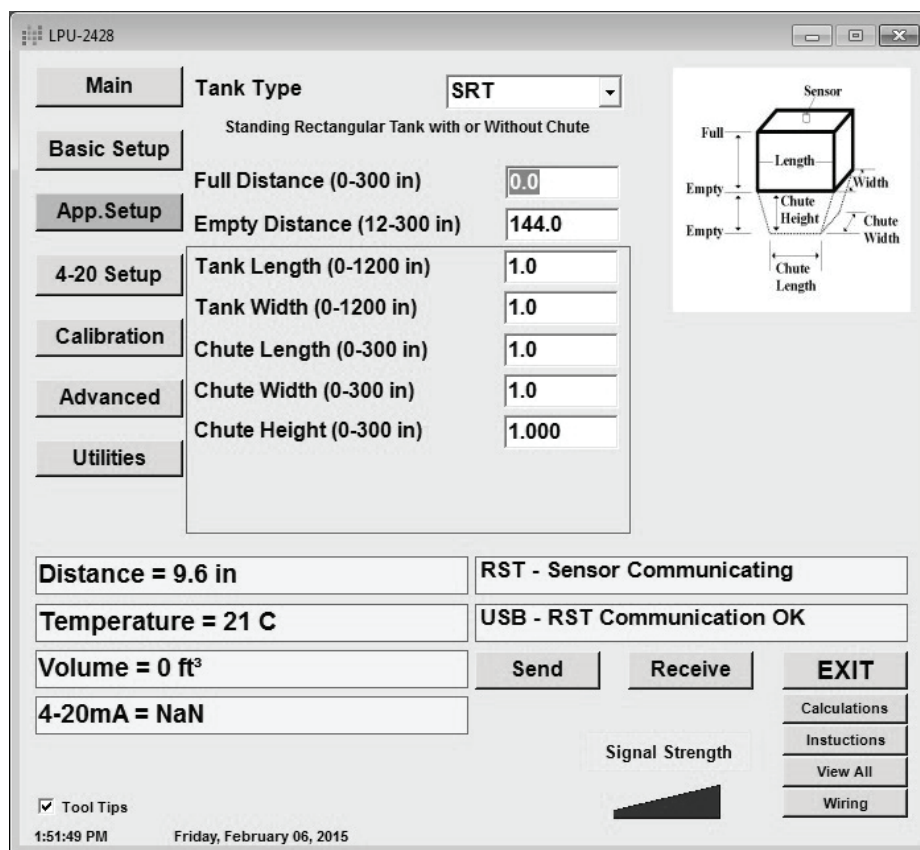


Figure 4.9

App/Out

Func	Parameter	RST-4001 Options	Software Options
Volume	<i>Radius of Hemi</i>	Default = 1.00	Default = 1.00
SCTWHB	<i>(Rad Hemi)</i>	0.00 - 25.00 Feet	0.00 - 25.00 Feet
HCT		0.0 - 300.0 Inch	00.0 - 300.0 Inches
		0.000 - 7.620 Meters	0.000 - 7.620 Meters
		000 - 7620 MM	000 - 7620 Millimeters

Radius of Hemi (*Rad Hemi* on the RST-4001) sets the radius of the hemisphere on the bottom (SCTWHB) or end (HCT) of a standing or horizontal cylindrical tank. (See Figures 4.7 and 4.10)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Volume	<i>Cone Diameter</i>	Default = 1.00	Default = 1.00
SCTWCB	<i>(Cone Dia)</i>	0.00 - 100.00 Feet	0.00 - 100.00 Feet
		0.0 - 1200.0 Inch	00.0 - 1200.0 Inches
		0.000 - 30.480 Meters	0.000 - 30.480 Meters
		000 - 30480 MM	000 - 30480 Millimeters

Cone Diameter (*Cone Dia* on the RST-4001) sets the lower diameter of the cone chute on a standing cylindrical tank (SCTWCB). (See Figure 4.8)

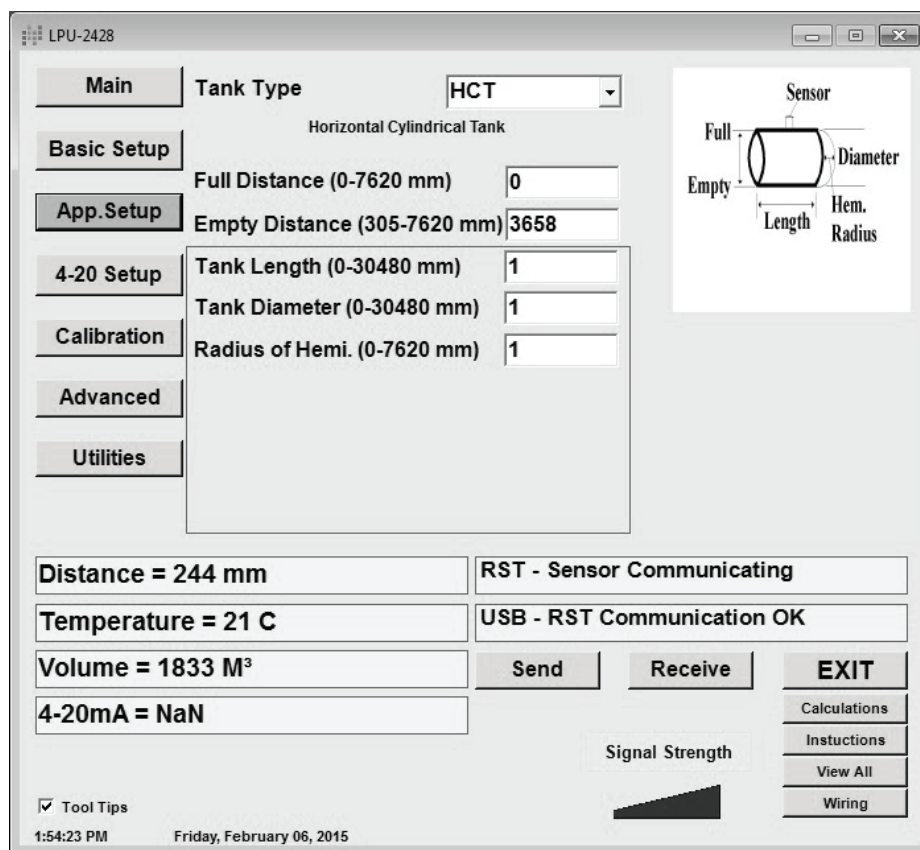


Figure 4.10

App/Out

Func	Parameter	RST-4001 Options	Software Options
Volume	<i>Cone Height</i>	Default = 1.00	Default = 1.00
SCTWCB	<i>(Cone Hei)</i>	0.00 - 25.00 Feet	0.00 - 25.00 Feet
		0.0 - 300.0 Inch	00.0 - 300.0 Inches
		0.000 - 7.620 Meters	0.000 - 7.620 Meters
		000 - 7620 MM	000 - 7620 Millimeters

Cone Height (Cone Hei on the RST-4001) sets the height of the cone chute on a SCTWCB. (See Figure 4.8)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Volume	<i>Tank Length</i>	Default = 1.00	Default = 1.00
SRT	<i>(T Length)</i>	0.00 - 100.00 Feet	0.00 - 100.00 Feet
HCT		0.0 - 1200.0 Inch	00.0 - 1200.0 Inches
		0.000 - 30.480 Meters	0.000 - 30.480 Meters
		000 - 30480 MM	000 - 30480 Millimeters

Tank Length (T Length on the RST-4001) sets the length of a rectangular (SRT) or horizontal cylindrical (HCT) tank. (See Figures 4.9 and 4.10)

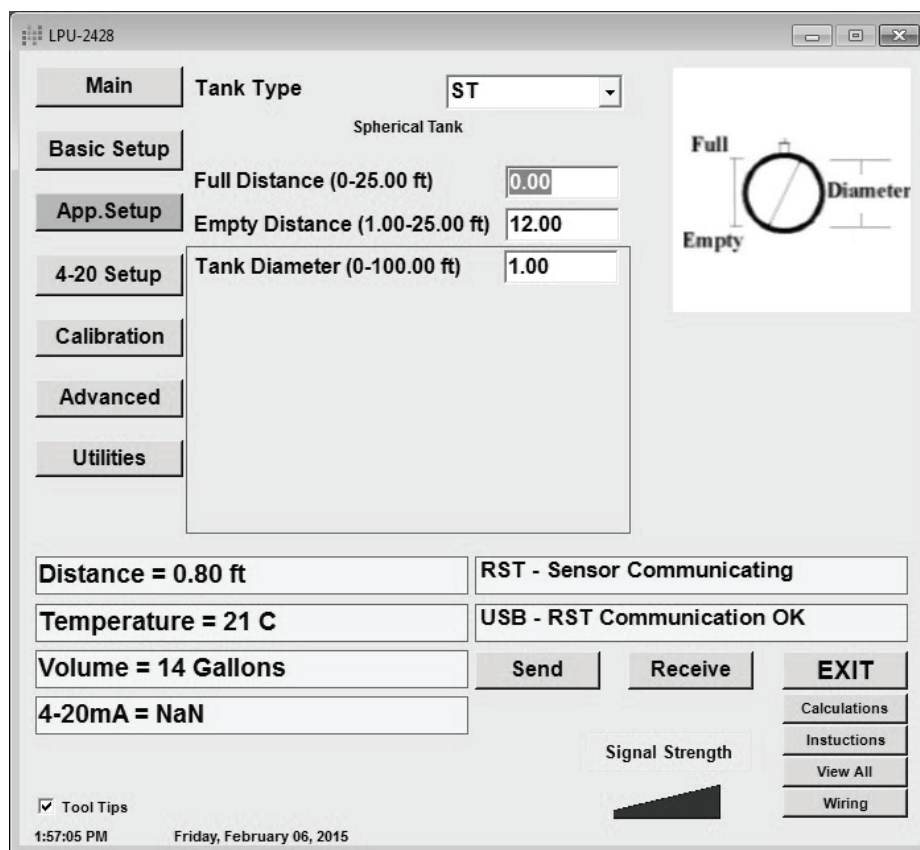


Figure 4.11

App/Out

Func	Parameter	RST-4001 Options	Software Options
Volume	<i>Tank Width</i>	Default = 1.00	Default = 1.00
SRT	<i>(T Width)</i>	0.00 - 25.00 Feet	0.00 - 25.00 Feet
		0.0 - 300.0 Inch	00.0 - 300.0 Inches
		0.000 - 7.620 Meters	0.000 - 7.620 Meters
		000 - 7620 MM	000 - 7620 Millimeters

Tank Width (*T Width* on the RST-4001) sets the width of a rectangular (SRT) tank. (See Figure 4.9)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Volume	<i>Chute Length</i>	Default = 1.00	Default = 1.00
SRT	<i>(C Length)</i>	0.00 - 25.00 Feet	0.00 - 25.00 Feet
		0.0 - 300.0 Inch	00.0 - 300.0 Inches
		0.000 - 7.620 Meters	0.000 - 7.620 Meters
		000 - 7620 MM	000 - 7620 Millimeters

Chute Length (*C Length* on the RST-4001) sets the length of a chute under a rectangular (SRT) tank. The length of the chute is in the same direction as the length of the tank. (See Figure 4.9)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Volume	<i>Chute Width</i>	Default = 1.00	Default = 1.00
SRT	(<i>C Width</i>)	0.00 - 25.00 Feet 0.0 - 300.0 Inch 0.000 - 7.620 Meters 000 - 7620 MM	0.00 - 25.00 Feet 00.0 - 300.0 Inches 0.000 - 7.620 Meters 000 - 7620 Millimeters

Chute Width (*C Width* on the RST-4001) sets the width of a chute under a rectangular (SRT) tank. The width of the chute is in the same direction as the width of the tank. (See Figure 4.9)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Volume	<i>Chute Height</i>	Default = 1.00	Default = 1.00
SRT	(<i>C Height</i>)	0.00 - 25.00 Feet 0.0 - 300.0 Inch 0.000 - 7.620 Meters 000 - 7620 MM	0.00 - 25.00 Feet 00.0 - 300.0 Inches 0.000 - 7.620 Meters 000 - 7620 Millimeters

Chute Height (*C Height* on the RST-4001) sets the height of a chute under a rectangular (SRT) tank. (See Figure 4.9)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Flow	<i>Flow Type</i> (<i>FlowType</i>)	Default = Flume Flume Weir Equation	Default = Flume Flume Weir Equation

Flow Type (*FlowType* on the RST-4001) selects the type of flow being monitored. (See Figures 4.12-4.22)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Flume	<i>Flume Type</i> (<i>Flume Ty</i>)	Default = Parshall Parshall CutThroa	Default = Parshall Parshall Cut Throat

Flume Type (*Flume Ty* on the RST-4001) selects the type of flume being monitored. (See Figure 4.12-4.13)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Weir	<i>Weir Type</i> (<i>Weir Typ</i>)	Default = Californ Californ Rect w/c Rect w/o Trapazod Triangul	Default = California Pipe California Pipe Rectangle w/Const Rectangle w/o Const Trapazoidal Triangular or V-Notch

Weir Type (*Weir Typ* on the RST-4001) selects the type of weir being monitored. (See Figure 4.14-4.18)

MPE

Main Flow Type **Flume**

Basic Setup Flume Type **Parshall**

App.Setup Max Flow (0-25.00 ft) **0.00**

Zero Flow (1.00-25.00 ft) **25.00**

4-20 Setup Constant K (0-89766) **1795.00**

Exponent n (0-2) **1.522**

Calibration

Advanced

Utilities

Totalization

Distance = 1.00 ft , 4.28 ft

Temperature = 21 C

Flow = 11 Gallons Per Min

4-20mA = NaN , NaN

RST - Sensor Com

USB - RST Commu

Send Receive EXIT

Signal Strength

Units = Feet
Flow Units= Gallons
Flow Rate = Per Minute

Select Width

1 ft 1 ft 2 ft 3 ft 4 ft 5 ft 6 ft 7 ft 8 ft

Insert

$Q=KH^n$

Diagram: A diagram of a Parshall flume showing the width and the sensor location.

Tool Tips: ☒ Tool Tips

2:09:03 PM Friday, February 06, 2015

Figure 4.12

MPE

Main Flow Type **Flume**

Basic Setup Flume Type **Cut Throat**

App.Setup Max Flow (0-25.00 ft) **0.00**

Zero Flow (1.00-25.00 ft) **25.00**

4-20 Setup Constant K (0-3591) **1795.00**

Exponent n1 (0-2) **1.522**

Calibration Throat Width (0-25.00 ft) **1.000** ft

Exponent n2 (0-2) **0.003**

Advanced

Utilities

Totalization

Distance = 1.00 ft , 4.42 ft

Temperature = 21 C

Flow = 11 Gallons Per Min

4-20mA = NaN , NaN

RST - Sensor Com

USB - RST Communication OK

Send Receive EXIT

Signal Strength

Units = Feet
Flow Units= Gallons
Flow Rate = Per Minute

Select Length_Width

Cut Throat 9 ft (L) 1 ft (W) 9 ft (L) 2 ft (W) 9 ft (L) 4 ft (W) 9 ft (L) 6 ft (W) 4.5 ft (L) 0.25 ft (W) 4.5 ft (L) 0.5 ft (W) 4.5 ft (L) 1 ft (W) 4.5 ft (L) 2 ft (W)

Insert

$Q=KW^{n1}H^{n2}$

Diagram: A diagram of a Cut Throat flume showing the sensor location, width, and length.

Tool Tips: ☒ Tool Tips

2:11:24 PM Friday, February 06, 2015

Figure 4.13

The screenshot shows the LPU-2428 software interface. On the left, there are tabs for Main, Basic Setup, App.Setup, 4-20 Setup, Calibration, Advanced, Utilities, and Totalization. The 'App.Setup' tab is active, displaying fields for Flow Type (Weir), Weir Type (California Pipe), Max Flow (0.00), Zero Flow (25.00), Constant K (1795.0), Exponent n1 (1.522), Diameter of Pipe (1.000 ft), and Exponent n2 (0.003). A diagram on the right shows a pipe with a sensor and flow measurement points labeled 'Max' and 'Zero'. Below the diagram is the formula $Q=K(H/D)^{n1}D^{n2}$ and unit definitions. At the bottom, there are status boxes for Distance (1.00 ft), Temperature (21 C), Flow (1795 Gallons Per Min), and 4-20mA (NaN). Communication status shows 'RST - Sensor Communicating' and 'USB - RST Communication OK'. A 'Signal Strength' indicator is present, along with buttons for Send, Receive, EXIT, Calculations, Instructions, View All, and Wiring. The bottom status bar shows '2:17:10 PM' and 'Friday, February 06, 2015'.

Figure 4.14

App/Out

Func	Parameter	RST-4001 Options	Software Options
Equation	Equation (Equation)	Default = 1	Default = $Q=KH^n$
		1	$Q=KH^n$
		2	$Q=KLH^n$
		3	$Q=K[L-XH]H^n$
		4	$Q=K[B-A/D]^{n1}P^{n2}$

Equation (*Equation* on the RST-4001) selects the equation that best models the flow being monitored. (See Figure 4.19-4.22)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Flow	Max Flow (Max Flow)	Default = 1.00	Default = 1.00
		0.00 - 25.00 Feet	0.00 - 25.00 Feet
		0.0 - 300.0 Inch	00.0 - 300.0 Inches
		0.000 - 7.620 Meters	0.000 - 7.620 Meters
		000 - 7620 MM	000 - 7620 Millimeters

Max Flow (*Max Flow* on the RST-4001) sets the distance from the sensor to the maximum height of the flow. (See Figures 4.12-4.22)

MPE

Main Flow Type **Weir**

Basic Setup Weir Type **Rectangle w/Const.**

App.Setup Max Flow (0-25.00 ft) **0.00**
Zero Flow (1.00-25.00 ft) **25.00**

4-20 Setup Constant K (0-3142) **7180.00**
Exponent n (0-2) **1.523**

Calibration Crest Length (0-25.00 ft) **119410592** ft

Advanced

Utilities

Totalization

Distance = 1.00 ft , 25.00 ft **RST - Sensor Communicating**

Temperature = 21 C **USB - RST Communication OK**

Flow = 1795 Gallons Per Min **Send** **Receive** **EXIT**

4-20mA = NaN , NaN

Signal Strength

☒ Tool Tips

2:23:06 PM Friday, February 06, 2015

Sensor

Crest Length

Max

Zero

$Q=K(L-0.2H)H^n$

Units = Feet
Flow Units= Gallons
Flow Rate = Per Minute

Default Parameters
K=1495 ~1.500 **Insert**

Figure 4.15

MPE

Main Flow Type **Weir**

Basic Setup Weir Type **Rectangle w/o Const.**

App.Setup Max Flow (0-25.00 ft) **0.00**
Zero Flow (1.00-25.00 ft) **25.00**

4-20 Setup Constant K (0-3142) **3142.0**
Exponent n (0-2) **1.523**

Calibration Crest Length (0-25.00 ft) **10.00** ft

Advanced

Utilities

Totalization

Distance = 0.86 ft , 3.82 ft **RST - Sensor Communicating**

Temperature = 21 C **USB - RST Communication OK**

Flow = 1795 Gallons Per Min **Send** **Receive** **EXIT**

4-20mA = NaN , NaN

Signal Strength

☒ Tool Tips

2:25:34 PM Friday, February 06, 2015

Sensor

Crest Length

Max

Zero

$Q=KLH^n$

Units = Feet
Flow Units= Gallons
Flow Rate = Per Minute

Default Parameters
K=1495 ~1.500 **Insert**

Figure 4.16

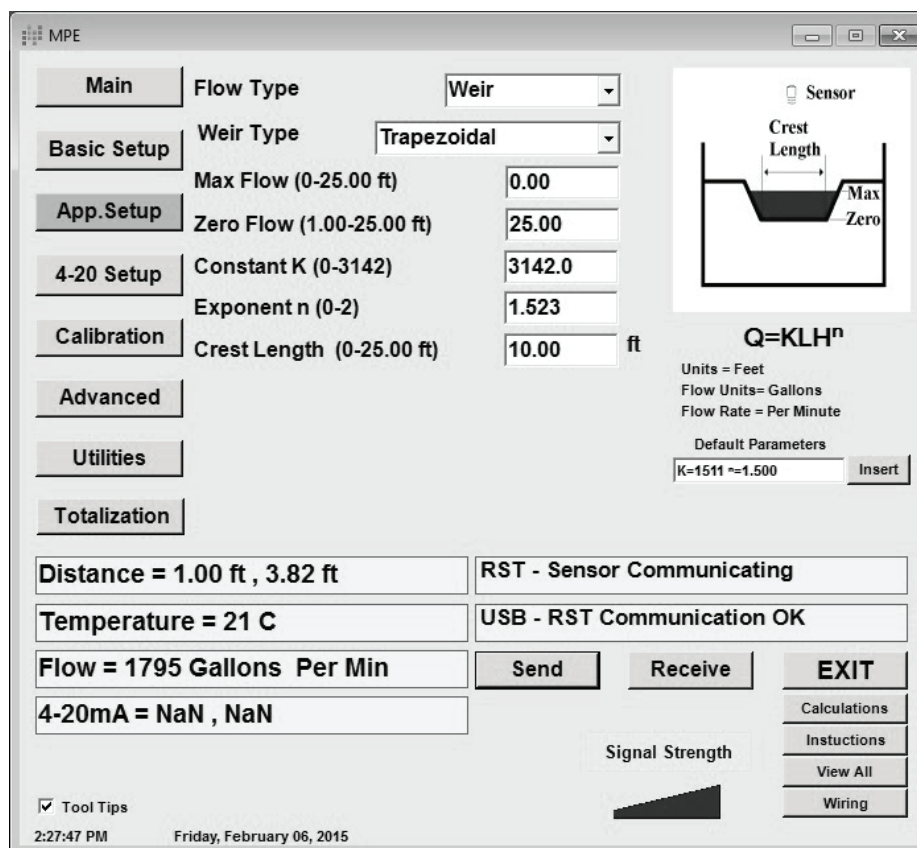


Figure 4.17

App/Out

Func	Parameter	RST-4001 Options	Software Options
Flow	Zero Flow (ZeroFlow)	Default = 1.00 0.00 - 25.00 Feet 0.0 - 300.0 Inch 0.000 - 7.620 Meters 000 - 7620 MM	Default = 1.00 0.00 - 25.00 Feet 00.0 - 300.0 Inches 0.000 - 7.620 Meters 000 - 7620 Millimeters

Zero Flow (ZeroFlow on the RST-4001) sets the distance from the sensor to the level of minimum flow. (See Figure 4.12-4.22)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Flow	Constant K (K)	Default = 1.00	Default = Varies

Constant K (K on the RST-4001) sets the flow coefficient K for the channel being monitored. The range for K varies for each application. Flume configurations have selectable widths that provide appropriate K values. Weir configurations include suggested K values on the right side of the screen. (See Figures 4.12-4.22)

MPE

Main Flow Type **Weir**

Basic Setup Weir Type **Triangular or V-Notch**

App. Setup Max Flow (0-25.00 ft) **0.00**

Zero Flow (1.00-25.00 ft) **25.00**

4-20 Setup Constant K (0-2020) **3142.0**

Exponent n (0-3) **1.523**

Calibration

Advanced

Utilities

Totalization

Distance = 1.00 ft , 3.82 ft **RST - Sensor Com**

Temperature = 21 C **USB - RST Communication OK**

Flow = 1795 Gallons Per Min **Send** **Receive** **EXIT**

4-20mA = NaN , NaN

Signal Strength

☒ Tool Tips

2:28:51 PM Friday, February 06, 2015

Q=KHⁿ

Units = Feet
Flow Units= Gallons
Flow Rate = Per Minute

Select Degree of Weir

V Notch **Insert**

22.5 Degree
30.0 Degree
45.0 Degree
60.0 Degree
90.0 Degree
120.0 Degree

Calculations
Instructions
View All
Wiring

Figure 4.18

MPE

Main Flow Type **Equation**

Basic Setup Equation **Q=KHⁿ**

App. Setup Max Flow (0-25.00 ft) **0.00**

Zero Flow (1.00-25.00 ft) **25.00**

4-20 Setup Constant K (0-10e308) **3142.00**

Exponent n (0-10e308) **1.523**

Calibration

Advanced

Utilities

Totalization

Distance = 35.41 ft , 4.30 ft **RST - Sensor Communicating**

Temperature = 21 C **USB - RST Communication OK**

Flow = 1795 Gallons Per Min **Send** **Receive** **EXIT**

4-20mA = NaN , NaN

Signal Strength

☒ Tool Tips

2:32:18 PM Friday, February 06, 2015

Q=KHⁿ

Units = Feet
Flow Units= Gallons
Flow Rate = Per Minute

Calculations
Instructions
View All
Wiring

Figure 4.19

MPE

Main | Flow Type | Equation

Basic Setup | Equation | $Q=KLH^n$

App.Setup | Max Flow (0-25.00 ft) | 0.00

Zero Flow (1.00-25.00 ft) | 25.00

4-20 Setup | Constant K (0-10e308) | 3142.00

Exponent n (0-10e308) | 1.523

Calibration | Length (0-10e308) | 10.000

Advanced

Utilities

Totalization

Distance = 1.00 ft , 4.30 ft | **RST - Sensor Communicating**

Temperature = 21 C | **USB - RST Communication OK**

Flow = 1795 Gallons Per Min | **Send** | **Receive** | **EXIT**

4-20mA = NaN , NaN

Signal Strength

☒ Tool Tips

2:35:39 PM | Friday, February 06, 2015

Units = Feet
Flow Units= Gallons
Flow Rate = Per Minute

Q=KLHⁿ

Calculations
 Instructions
 View All
 Wiring

Figure 4.20

App/Out

Func	Parameter	RST-4001 Options	Software Options
Flow	Exponent n / $n1$ (n / $N1$)	Default = 1.00	Default = varies

Exponent n or $n1$ (n or $N1$ on the RST-4001) sets the value of the (first) exponent for the channel being monitored. The range for n or $n1$ varies for each application. Flume configurations have selectable widths that provide appropriate n or $n1$ values. Weir configurations include suggested n or $n1$ values on the right side of the screen. (See Figures 4.12-4.22)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Flow	Exponent $n2$	Default = 1.00	Default = varies

Cutthroat ($N2$)

Cal. Pipe

$$Q=K[B-A/D]^{n1}P^{n2}$$

Exponent $n2$ ($N2$ on the RST-4001) sets the value of the second exponent for Cutthroat flume and California pipe weirs being monitored. The range for $n2$ varies for each application. Flume configurations have selectable widths that provide appropriate $n2$ values. Weir configurations include suggested $n2$ values on the right side of the screen. (See Figures 4.13, 4.14, and 4.22)

MPE

Main Flow Type Equation

Basic Setup Equation $Q=K[L-XH]H^n$

App.Setup Max Flow (0-25.00 ft) 0.00

Zero Flow (1.00-25.00 ft) 25.00

4-20 Setup Constant K (0-10e308) 3142.00

Exponent n (0-10e308) 1.523

Calibration Length (0-10e308) 10.000 ft $Q=K(L-XH)H^n$

Advanced Constant X (0-10e308) 0.005

Units = Feet
Flow Units= Gallons
Flow Rate = Per Minute

Utilities

Totalization

Distance = 1.00 ft , 4.30 ft RST - Sensor Communicating

Temperature = 21 C USB - RST Communication OK

Flow = 1795 Gallons Per Min Send Receive EXIT

4-20mA = NaN , NaN

Signal Strength

☒ Tool Tips

2:36:19 PM Friday, February 06, 2015

Calculations
Instructions
View All
Wiring

Figure 4.21

MPE

Main Flow Type Equation

Basic Setup Equation $Q=k[B-A/D]^{n1}P^{n2}$

App.Setup Max Flow (0-25.00 ft) 0.00

Zero Flow (1.00-25.00 ft) 25.00

4-20 Setup Constant K (0-10e308) 3142.00

Exponent n1 (0-10e308) 1.523

Calibration Constant D (0-10e308) 10.000

Advanced Exponent n2 (0-10e308) 0.005

$Q=K(B-A/D)^{n1}P^{n2}$

Units = Feet
Flow Units= Gallons
Flow Rate = Per Minute

Utilities

Totalization

Distance = 1.00 ft , 4.30 ft RST - Sensor Communicating

Temperature = 21 C USB - RST Communication OK

Flow = 1795 Gallons Per Min Send Receive EXIT

4-20mA = NaN , NaN

Signal Strength

☒ Tool Tips

2:37:01 PM Friday, February 06, 2015

Calculations
Instructions
View All
Wiring

Figure 4.22

App/Out

Func	Parameter	RST-4001 Options	Software Options
Flow - Flume	<i>Throat Width</i>	Default = 1.00	Default = 1.00
Cut Throat	(<i>Throat W</i>)	0.00 - 25.00 Feet 0.0 - 300.0 Inch 0.000 - 7.620 Meters 000 - 7620 MM	0.00 - 25.00 Feet 00.0 - 300.0 Inches 0.000 - 7.620 Meters 000 - 7620 Millimeters

Throat Width (*Throat W* on the RST-4001) sets the width of a Cut Throat flume. Length and width combinations can be selected from the right side of the screen. (See Figure 4.13)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Flow - Weir	<i>Diameter of Pipe</i>	Default = 1.00	Default = 1.00
Calif. Pipe	(<i>Diameter</i>)	0.00 - 25.00 Feet 0.0 - 300.0 Inch 0.000 - 7.620 Meters 000 - 7620 MM	0.00 - 25.00 Feet 00.0 - 300.0 Inches 0.000 - 7.620 Meters 000 - 7620 Millimeters

Diameter of Pipe (*Diameter* on the RST-4001) sets the diameter of a California Pipe type weir. (See Figure 4.14)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Flow - Weir	<i>Crest Length</i>	Default = 1.00	Default = 1.00
Rect w/cst	(<i>C Length</i>)	0.00 - 25.00 Feet	0.00 - 25.00 Feet
Rect w/o cst		0.0 - 300.0 Inch	00.0 - 300.0 Inches
Trapezoidal		0.000 - 7.620 Meters 000 - 7620 MM	0.000 - 7.620 Meters 000 - 7620 Millimeters

Crest Length (*C Length* on the RST-4001) sets the crest length for Rectangular (with and without constriction) and Trapezoidal weirs. (See Figures 4.15, 4.16, and 4.17)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Flow - Eq	<i>Length</i>	Default = 1.000	Default = 10.000
$Q=KLH^n$	(<i>Length</i>)		0 - 10e308 (ft)
$Q=K[L-XH]H^n$			

Length (*Length* on the RST-4001) sets the value of the L variable in the flow equations. Length can be set using the RST-4001, but can only be adjusted by 0.001 increments using the UP and DOWN arrows. (See Figures 4.20, 4.21, and 4.1)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Flow - Eq	<i>Constant X</i>	Default = 1.000	Default = 0.006
$Q=K[L-XH]H^n$	(<i>X</i>)		0 - 10e308

Constant X (*X* on the RST-4001) sets the value of the X constant in the flow equation $Q=K[L-XH]H^n$. X can be set using the RST-4001, but can only be adjusted by 0.001 increments using the UP and DOWN arrows. (See Figures 4.21 and 4.1)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Flow - Eq	<i>Constant D</i>	Default = 1.000	Default = 10.000
	$Q=K[B-A/D]^{n1}P^{n2}$ (<i>Diameter</i>)		0 - 10e308
<i>Constant D</i> (<i>Diameter</i> on the RST-4001) sets the value of the D constant in the flow equation $Q=K[B-A/D]^{n1}P^{n2}$. Diameter can be set using the RST-4001, but can only be adjusted by 0.001 increments using the UP and DOWN arrows. (See Figures 4.22 and 4.1)			

App/Out

Func	Parameter	RST-4001 Options	Software Options
Lin. Tab.	<i>Max Distance</i>	-----	Default = 1.00 Feet 0.00 - 25.00 Feet 00.0 - 300.0 Inches 0.000 - 7.620 Meters 000 - 7620 Millimeters

Max Distance (not configurable on the RST-4001) sets the distance from the sensor to the point of maximum volume for a linear table. (See Figure 4.23)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Lin. Tab	<i>Zero Distance</i>	-----	Default = 20.00 Feet 1.00 - 25.00 Feet 12.0 - 300.0 Inches 0.305 - 7.620 Meters 305 - 7620 Millimeters

Zero Distance (not configurable on the RST-4001) sets the distance from the sensor to the point of zero volume for a linear table. (See Figure 4.23)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Submers	<i>Submersible Range</i> (<i>SubRange</i>)	Default = 1.00 (ft) 0.00 - 25.00 Feet 0.0 - 300.0 Inch 0.000 - 7.620 Meters 000 - 7620 MM	Default = 1.00 Feet 0.00 - 25.00 Feet 00.0 - 300.0 Inches 0.000 - 7.620 Meters 000 - 7620 Millimeters

Sumersible Range (*Sub Range* on the RST-4001) sets distance from the sensor to point at which a hypothetical pressure transducer would be submerged. (See Figure 4.24)

App/Out

Func	Parameter	RST-4001 Options	Software Options
Submers	<i>Depth Distance</i> (<i>Depth</i>)	Default = 25.00 (ft) 0.00 - 25.00 Feet 0.0 - 300.0 Inch 0.000 - 7.620 Meters 000 - 7620 MM	Default = 20.00 Feet 0.00 - 25.00 Feet 00.0 - 300.0 Inches 0.000 - 7.620 Meters 000 - 7620 Millimeters

Depth Distance (*Depth* on the RST-4001) represents the equivalent depth for the 20mA output setting of the sensor. (See Figures 4.24 and 4.25)

LPU-2428

Main

Linear Table

Basic Setup

App.Setup

Max Distance (0-25.00 ft)

Zero Distance (1.00-25.00 ft)

Loc	Distance (ft)	Value
1	1.00	1000
2	1.50	1500
3	2.00	2000
4	2.50	2500
5	3.00	3000
6	3.50	3500
7	4.00	4000

4-20 Setup

Loc	Distance (ft)	Value
1	0.00	0
2	0.00	0
3	0.00	0
4	0.00	0
5	0.00	0
6	0.00	0
7	0.00	0
8	0.00	0

Calibration

Advanced

Utilities

Totalization

Distance = 5.86 ft

Temperature = 21 C

Flow = 0 ft³ Per Min

4-20mA = 20.00

RST - Sensor Communicating

USB - RST Communication OK

Send **Receive** **EXIT**

Instructions

View All

Wiring

☒ Tool Tips

12:14:38 PM Thursday, February 05, 2015

Figure 4.23

LPU-2428

Main

Basic Setup

App.Setup

Submersible Range (0-25.00 ft)

Depth Distance (1.00-25.00 ft)

4-20 Setup

Calibration

Advanced

Utilities

Sensor

Zero

Distance = 7.57 ft

Temperature = 21 C

Volume = NA

4-20mA = NaN

RST - Sensor Communicating

USB - RST Communication OK

Send **Receive** **EXIT**

Instructions

View All

Wiring

☒ Tool Tips

12:20:10 PM Thursday, February 05, 2015

Figure 4.24

Transducer PSI to Milliamp Chart											
0-5 PSI	milliamp	Feet	0-10 PSI	milliamp	Feet	0-15 PSI	milliamp	Feet	0-100 PSI	milliamp	Feet
0	4.0	0.0	0	4.0	0.0	0	4.0	0.0	0	4.0	0.0
1	7.2	2.3	1	5.6	2.3	1	5.1	2.3	5	4.8	11.6
2	10.4	4.6	2	7.2	4.6	2	6.1	4.6	10	5.6	23.1
3	13.6	6.9	3	8.8	6.9	3	7.2	6.9	15	6.4	34.7
4	16.8	9.2	4	10.4	9.2	4	8.3	9.2	20	7.2	46.2
5	20.0	11.6	5	12.0	11.6	5	9.3	11.6	25	8.0	57.8
			6	13.6	13.9	6	10.4	13.9	30	8.8	69.3
			7	15.2	16.2	7	11.5	16.2	35	9.6	80.9
			8	16.8	18.5	8	12.5	18.5	40	10.4	92.4
			9	18.4	20.8	9	13.6	20.8	45	11.2	104.0
			10	20.0	23.1	10	14.7	23.1	20	7.2	46.2
						11	15.7	25.4	22	7.5	50.8
						12	16.8	27.7	60	13.6	138.6
						13	17.9	30.0	65	14.4	150.2
						14	18.9	32.3	70	15.2	161.7
						15	20.0	34.7	75	16.0	173.3
									80	16.8	184.8
									85	17.6	196.4
									90	18.4	207.9
									95	19.2	219.5
									100	20.0	231.0

Figure 4.25

• 4-20 Setup Menu (4-20 SET)

Menu	Parameter	RST-4001 Options	Software Options
4-20	<i>Min mA Setpoint</i>	Default = 1.00 (ft)	Default = 1.00 Feet
Setup	<i>(MinMaSet)</i>	0.00 - 25.00 Feet	0.00 - 25.00 Feet
		0.0 - 300.0 Inch	0.0 - 300.0 Inches
		0.000 - 7.620 Meters	0.000 - 7.620 Meters
		0000 - 7620 MM	0000 - 7620 Millimeters

Min mA Setpoint (MinMaSet on the RST-4001) sets the distance from the sensor to level corresponding to minimum output (4mA). (See Figures 4.26 - 4.28)

Menu	Parameter	RST-4001 Options	Software Options
4-20	<i>Max mA Setpoint</i>	Default = 20.00 (ft)	Default = 20.00 Feet
Setup	<i>(MaxMaSet)</i>	0.00 - 25.00 Feet	0.00 - 25.00 Feet
		0.0 - 300.0 Inch	0.0 - 300.0 Inches
		0.000 - 7.620 Meters	0.000 - 7.620 Meters
		0000 - 7620 MM	0000 - 7620 Millimeters

Min mA Setpoint (MinMaSet on the RST-4001) sets the distance from the sensor to level corresponding to maximum output (20mA). (See Figures 4.26 - 4.28)

LPU-2428

Main Min mA Setpoint 1.00 (0 - 20.00 ft)

Basic Setup Max mA Setpoint 1.00 (0 - 20.00 ft)

App. Setup Fail Safe Hold

4-20 Setup Fail Safe Delay 15 15-9999 Sec

Calibration

Advanced

Utilities

Distance = 5.29 ft RST - Sensor Communicating

Temperature = 21 C USB - RST Communication OK

Volume = NA Send Receive EXIT

4-20mA = NaN

Instructions

View All

Wiring

☒ Tool Tips

12:21:44 PM Thursday, February 05, 2015

Figure 4.26

Menu	Parameter	RST-4001 Options	Software Options
4-20	Fail Safe	Default = 3.8 MA	Default = Hold
Setup	(FailSafe)	3.8 MA	Hold
		22 MA	3.8 mA
		Hold	22mA

Fail Safe (*FailSafe* on the RST-4001) sets the output condition that the sensor will revert to in the event of a loss of echo condition. If Fail Safe is set to Hold, the sensor will hold the last reading until the signal is regained. (See Figure 4.26)

Menu	Parameter	RST-4001 Options	Software Options
4-20	Fail Safe Delay	Default = 15 (sec)	Default = 15 sec
Setup	(FS Delay)	15 - 9999	15 - 9999 sec

Fail Safe (*FailSafe* on the RST-4001) sets the delay, in seconds, before the output shows the loss of echo condition set in Fail Safe. When this time has expired, the output will change to the Fail Safe settings. (See Figure 4.26)

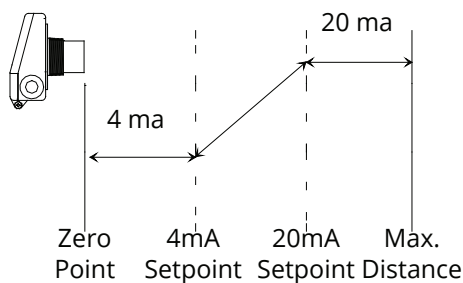


Figure 4.27

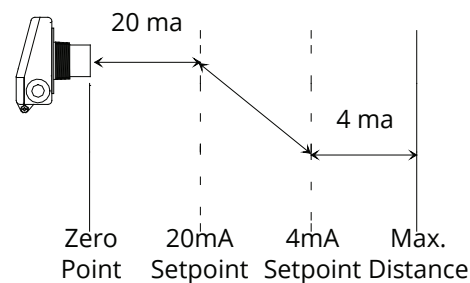


Figure 4.28

• Calibration (CALIBRAT)

Menu	Parameter	RST-4001 Options	Software Options
Calib.	Min mA Value (MinMaVal)	Default = 4.00 4.00 - MaxMaVal	Default = 4.00 4.00 - Max mA Value

Min mA Value (MinMaVal on the RST-4001) sets the minimum current output of the sensor. (See Figure 4.29)

Menu	Parameter	RST-4001 Options	Software Options
Calib.	Max mA Value (MaxMaVal)	Default = 20.00 MinMaVal - 20.00	Default = 20.00 Min mA Value - 20.00

Max mA Value (MaxMaVal on the RST-4001) sets the maximum current output of the sensor. (See Figure 4.29)

Menu	Parameter	RST-4001 Options	Software Options
Calib.	Min mA Trim (Min Trim)	Default = 500 0 - 999	Default = 500 0 - 999

Min mA Trim (Min Trim on the RST-4001) fine tunes the minimum current output of the sensor. (See Figure 4.29)

Menu	Parameter	RST-4001 Options	Software Options
Calib.	Max mA Trim (Max Trim)	Default = 500 0 - 999	Default = 500 0 - 999

Max mA Trim (Max Trim on the RST-4001) fine tunes the maximum current output of the sensor. (See Figure 4.29)

Menu	Parameter	RST-4001 Options	Software Options
Calib.	Multiplier (Multipli)	Default = 1.000 0.000 - 1.999	Default = 1.000 0.000 - 1.999

Multiplier (Multipli on the RST-4001) calibrates the sensor for variations in the speed of sound due to variations in atmospheres. The default of 1.000 is used for most applications. (See Figure 4.29)

Menu	Parameter	RST-4001 Options	Software Options
Calib.	Offset (Offset)	Default = 0.00 - 3.00 - 3.00 (ft)	Default = 0.00 - 3.00 - 3.00 (ft)

Offset (Offset on the RST-4001) is used to change the Zero Point of the sensor. This not the zero output (4 mA) point of the sensor. The Zero Point of the sensor is the point from which the calculated distance is measured. (See Figures 4.27, 4.28, and 4.29)

The screenshot shows the LPU-2428 software interface. On the left is a vertical menu with buttons: Main, Basic Setup, App. Setup, 4-20 Setup, Calibration, Advanced, and Utilities. The main area displays configuration parameters for each menu. Under 'Main', 'Min mA Value (4.00 - MaxMa Value)' is set to 20.00. Under 'Basic Setup', 'Max mA Value (MinMa Value - 20.00)' is 20.00. Under 'App. Setup', 'Min mA Trim (0 - 999)' is 400 and 'Max mA Trim (0 - 999)' is 500. Under '4-20 Setup', 'Multiplier (0 - 1.999)' is 1.000. Under 'Calibration', 'Offset (-3ft to +3ft)' is 0.00. The 'Advanced' menu is currently selected. At the bottom, status information is displayed: 'Distance = 5.86 ft', 'Temperature = 21 C', 'Volume = NA', and '4-20mA = NaN'. To the right of this is a box showing 'RST - Sensor Communicating' and 'USB - RST Communication OK'. Below the status box are 'Send', 'Receive', and 'EXIT' buttons. At the bottom right are buttons for 'Instructions', 'View All', and 'Wiring'. At the bottom left, there is a 'Tool Tips' checkbox (checked) and a timestamp '12:22:21 PM Thursday, February 05, 2015'.

Figure 4.29

- **Advanced (ADVANCED)**

Menu	Parameter	RST-4001 Options	Software Options
Advncd	Temp. Comp. (TempComp)	Default = ON ON / OFF	Default = ON ON / OFF

Temperature Compensation (TempComp on the RST-4001) activates or deactivates the internal temperature compensation circuit. The speed of sound changes with changes in temperature, therefore changes in temperature can affect distance measurements. (See Figure 4.30)

Menu	Parameter	RST-4001 Options	Software Options
Advncd	Gain Control (GainCont)	Default = AutoSens AutoSens HardTarg SoftTarg Manual	Default = AutoSense Manual AutoSense Hard Target Soft Target

Gain Control (GainCont on the RST-4001) selects the control mode for the sensor's gain settings (Sensitivity and Pulses). In AutoSense, the sensor automatically adjusts the sensitivity and pulses for the best quality return signal. Manual, Hard Target, and Soft Target are user controlled scenarios. In Manual, the user is in full control of sensitivity and pulses. For Hard and Soft Target, the user sets sensitivity and pulses, but the overall gain is either ramped up slowly (Hard Target) or quickly (Soft Target) by the sensor. (See Figure 4.30)

LPU-2428

Main

Basic Setup

App. Setup

4-20 Setup

Calibration

Advanced

Utilities

Temperature Compensation **ON**

Gain Control **Manual**

Sensitivity (0 - 100) % **100**

Pulses (0 - 16) **16**

Blanking (1.00 - 25.00ft) **1.00**

Distance = 5.86 ft

Temperature = 21 C

Volume = NA

4-20mA = NaN

RST - Sensor Communicating

USB - RST Communication OK

Send **Receive** **EXIT**

☒ Tool Tips

12:23:36 PM Thursday, February 05, 2015

Instructions

View All

Wiring

Figure 4.30

Menu	Parameter	RST-4001 Options	Software Options
Advncd	<i>Sensitivity</i> (<i>Sensitiv</i>)	Default = 85% 0 - 100%	Default = 100% 0 - 100%

Sensitivity (*Sensitiv* on the RST-4001) sets the amount of gain applied to the recieved signal. For gain control settings Auto Sense, Hard Target, and Soft Target, this setting limits the maximum gain applied by the sensor. (See Figure 4.30)

Menu	Parameter	RST-4001 Options	Software Options
Advncd	<i>Pulses</i> (<i>Pulses</i>)	Default = 16 0 - 16	Default = 16 0 - 16

Pulses (*Pulses* on the RST-4001) sets number ultrasonic pulses per transmission burst. For gain control settings Auto Sense, Hard Target, and Soft Target, this setting limits the maximum number of pulses used by the sensor. The more pulses that are sent in a burst, the stronger the returning echo. When operating in Manual, increase the strength of the transmission by increasing the number of pulses for detecting soft targets in damping environments. In acoustically active environments or small enclosed areas, decrease the number of pulses to reduce multiple echoes. (See Figure 4.30)

Menu	Parameter	RST-4001 Options	Software Options
Advncd	<i>Blanking</i> (<i>Blanking</i>)	Default = 1.00 (ft) 0.00 - 25.00 Feet 0.0 - 300.0 Inch 0.000 - 7.620 Meters 0000 - 7620 MM	Default = 1.00 (ft) 1.00 - 25.00 Feet 12.0 - 300.0 Inches 0.305 - 7.620 Meters 305 - 7620 Millimeters

Blanking (*Blanking* on the RST-4001) sets the Blanking distance, which is the zone from the sensor to a point where the first echo will be accepted. Blanking distance is used to ignore unwanted targets -- such as welds, seams, pipe fittings, or gaskets -- between the sensor and the closest acceptable target level. Because of the physical properties of an ultrasonic sensor, objects cannot be detected closer than approximately 1 foot from the face of the transducer. This distance varies according to how much energy is being transmitted and the installation. Low pulses and soft mounting may allow target detection as close as 6 inches. (See Figure 4.30)

• Utilities (UTILITIE)

Menu	Parameter	RST-4001 Options	Software Options
Utilities	<i>Low Distance Simulation</i> (<i>LoDisSim</i>)	Default = 1.00 (ft) 0.00 - 25.00 Feet 0.0 - 300.0 Inch 0.000 - 7.620 Meters 0000 - 7620 MM	Default = 1.00 (ft) 1.00 - 25.00 Feet 12.0 - 300.0 Inches 0.305 - 7.620 Meters 305 - 7620 Millimeters

Low Distance Simulation (*LoDisSim* on the RST-4001) sets the low distance point for simulation. (See Figure 4.31)

Menu	Parameter	RST-4001 Options	Software Options
Utilities	<i>High Distance Simulation</i> (<i>HiDisSim</i>)	Default = 1.00 (ft) 0.00 - 25.00 Feet 0.0 - 300.0 Inch 0.000 - 7.620 Meters 0000 - 7620 MM	Default = 1.00 (ft) 1.00 - 25.00 Feet 12.0 - 300.0 Inches 0.305 - 7.620 Meters 305 - 7620 Millimeters

High Distance Simulation (*HiDisSim* on the RST-4001) sets the high distance point for simulation. (See Figure 4.31)

Menu	Parameter	RST-4001 Options	Software Options
Utilities	<i>Simulation Cycle Time</i> (<i>SimCycle</i>)	Default = Off Off 10 - 9999 seconds = On	Default = Off 0 - 9 seconds = Off 15 - 9999 seconds = On

Simulation Cycle Time (*SimCycle* on the RST-4001) sets the running time for a cycle simulation between the low distance point and high distance point set above. (See Figure 4.31)

Menu	Parameter	RST-4001 Options	Software Options
Utilities	<i>Reset</i> (<i>Reset</i>)	Default = No Reset No Reset Sensor Total	Default = No Reset No Reset Sensor Reset

Reset (*Reset* on the RST-4001) resets the sensor to factory defaults. (See Figure 4.31)

The screenshot shows the LPU-2428 software interface with the following sections:

- Navigation Menu:** Main, Basic Setup, App. Setup, 4-20 Setup, Calibration, Advanced, Utilities.
- Simulation Settings:**
 - Low Distance Simulation 1.00 - 20.00 ft: 1.00
 - High Distance Simulation 1.00 - 20.00 ft: 2.25
 - Simulation Cycle Time: ☐ ON, 9, 15-9999 Sec
- Reset and File System:**
 - Reset: No Reset (dropdown), GO
 - File System: Select (dropdown), GO
- Software Version:** 1
- Status and Controls:**
 - Distance = 5.86 ft
 - Temperature = 21 C
 - Volume = NA
 - 4-20mA = NaN
 - RST - Sensor Communicating
 - USB - RST Communication OK
 - Buttons: Send, Receive, EXIT
 - Buttons: Instructions, View All, Wiring
- Footer:**
 - ☒ Tool Tips
 - 12:24:31 PM Thursday, February 05, 2015

Figure 4.31

Menu	Parameter	RST-4001 Options	Software Options
Utilities	Reset (Reset)	Default = No Reset No Reset Sensor Total	Default = No Reset No Reset Sensor Reset

Reset (*Reset* on the RST-4001) resets the sensor to factory defaults. The Total option on the RST-4001 resets the resettable totalizer. (See Figure 4.31)

Menu	Parameter	RST-4001 Options	Software Options
Utilities	File System	-----	Default = None Sensor to File File to Sensor Compare Sensor to File None

File System (not configurable on the RST-4001) allows the user to edit, save, and load text files containing sensor parameters. (See Figure 4.31)

Menu	Parameter	RST-4001 Options	Software Options
Utilities	Software Version (Version)		

Software Version (*Version* on the RST-4001) displays the current software version running on the sensor. (See Figure 4.31)

- **Totalization (TOTALIZE)**

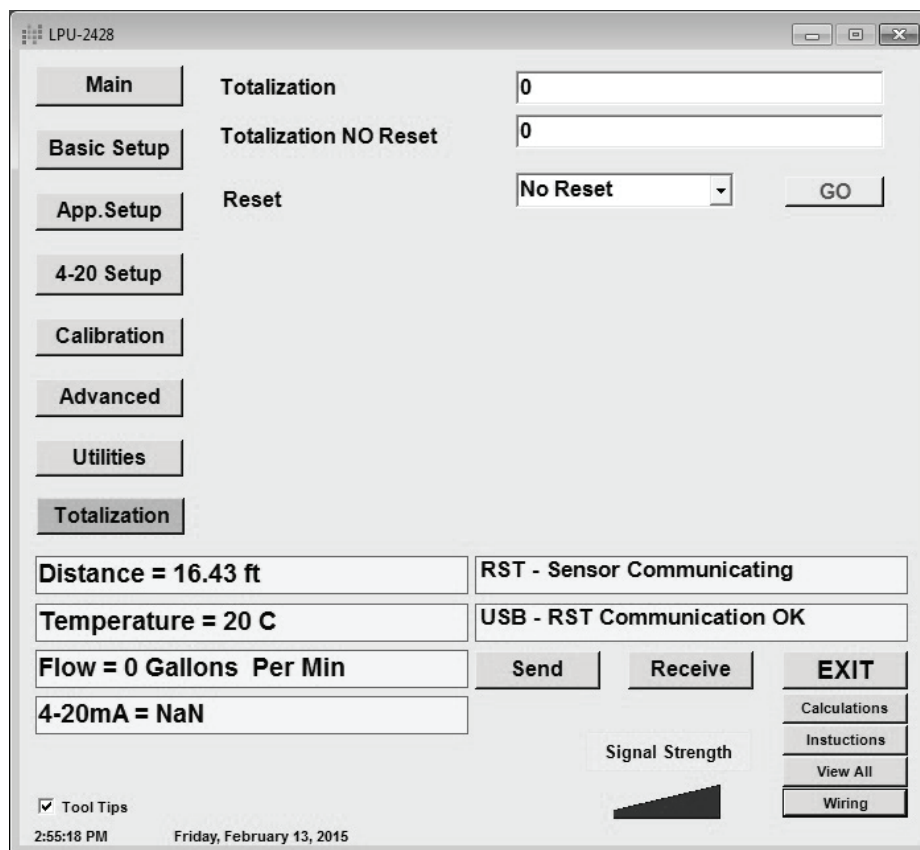
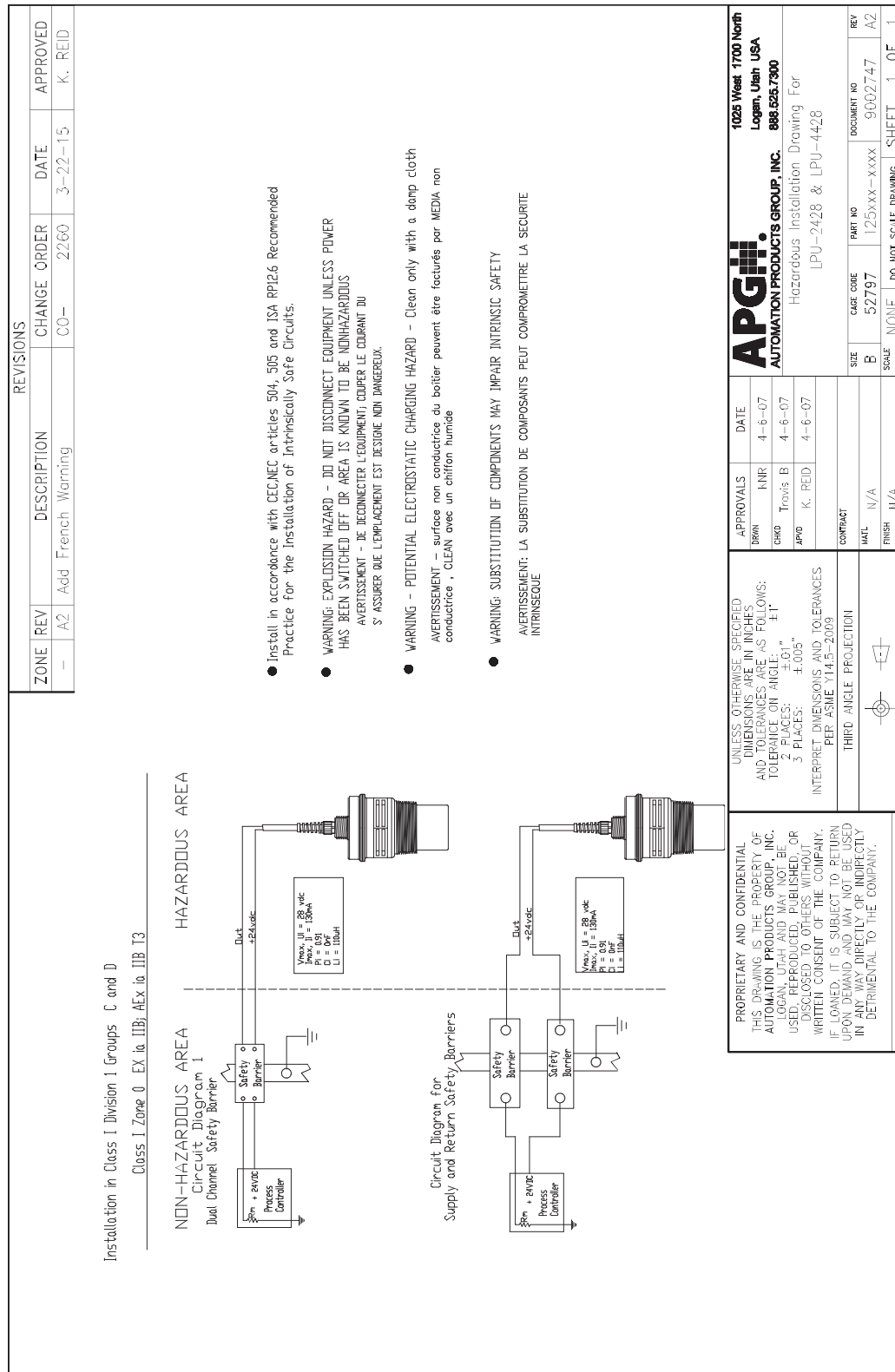


Figure 4.32

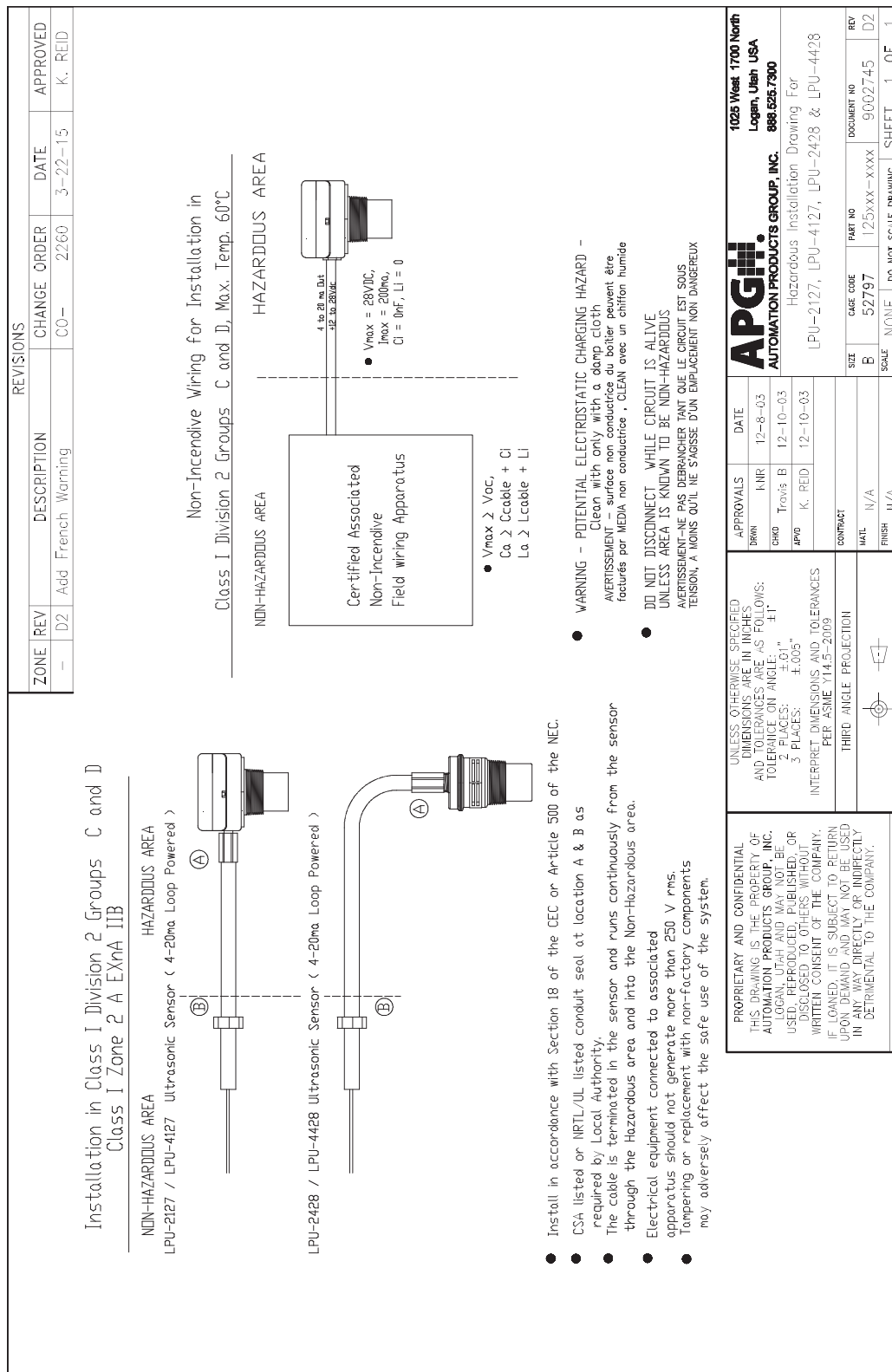
Menu	Parameter	RST-4001 Options	Software Options
Flow	Totalization (TOTALIZE)	Tot Rese Tot NonR -----	Totalization Totalization NO Reset Reset

Totalization (TOTALIZE on the RST-4001) is a submenu available only when Flow is the selected Application/ OutFunc. The sensor writes to two totalizers--one of which can be reset--and updates the totals to the LPU-2428 software in one minute increments. To reset the resettable totalizer via the RST-4001 use the UTILITIE menu. (See Figure 4.32)

- **Intrinsically Safe Wiring Diagram**



- **Hazardous Location Wiring Diagram**



- **CSA Certificate of Compliance**



Certificate of Compliance

Certificate: 1911747

Master Contract: 237484

Project: 2386064

Date Issued: April 29, 2011

Issued to: Automation Products Group Inc

1025 West 1700 North
Logan, UT 84321
USA

Attention: Karl Reid

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.



Rawn Murphy

Issued by: Rawn Murphy

PRODUCTS

CLASS 2258 82 - PROCESS CONTROL EQUIPMENT - For Hazardous Locations -
Certified to US Standards

CLASS 2258 02 - PROCESS CONTROL EQUIPMENT - For Hazardous Locations

Class I, Division 2, Groups C and D, T6

Ex nA IIB T6; IP65

Class I, Zone 2; AEx nA IIB T6; IP65

LPU Series Ultrasonic Sensors, Models LPU-2127, LPU-4127, LPU-2428 and LPU 4428; Rated input 12 to 28Vdc, Outputs 4-20mA; Ambient temperature range -40°C to +60°C.

LOE Series Ultrasonic Sensors, Models LOE-2126, LOE-6126, and LOE-3136; Rated input 48VDC or 12 to 28Vdc, 200 mA containing two optically-coupled MOSFET solid-state relay outputs rated 1500 Vr.m.s isolation voltage; Ambient temperature range -40°C to +60°C.

Note:

1) The LOE Series shall be powered by a suitable certified Class 2 power supply.



Certificate: 1911747

Master Contract: 237484

Project: 2386064

Date Issued: April 29, 2011

CLASS 2258 04 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe, Entity - For Hazardous Locations

CLASS 2258 84 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe, Entity - For Hazardous Locations - Certified to US Standards

Class I, Division 1, Groups C and D, T3

Ex ia IIB, T3 (Canada); IP65

Class I, Zone 0; AEx ia IIB, T3 (USA); IP65

LPU-2428 and LPU-4428 ultrasonic sensors; Rated input 12 to 28VDC, Outputs 4-20mA, Ambient temperature range -40°C to +60°C. Entity Parameters $V_{max} = 28VDC$, $I_{max} = 130mA$, $P_i = 0.91W$, $C_i = 0nF$, $L_i = 110\mu H$, intrinsically safe when connected in accordance with Installation drawing 9002747.

APPLICABLE REQUIREMENTS

CAN/CSA Standard C22.2 No. 0-M91	General Requirements - Canadian Electrical Code, Part II
CSA Standard C22.2 No.142-M1987	Process Control Equipment Industrial Products
CAN/CSA Standard C22.2 No.157-92	Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations
CAN/CSA Standard C22.2 No.213-M1987	Non-incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations Industrial Products
CAN/CSA Standard E60079-0-02	Electrical Apparatus for Explosive Gas Atmospheres – Part 0: General Requirements
CAN/CSA Standard E60079-11-02	Electrical Apparatus for Explosive Gas Atmospheres – Part 11: Intrinsic Safety "i"
CAN/CSA Standard E60079-15-02	Electrical Apparatus for Explosive Gas Atmospheres - Part 15: Type of Protection "n"
CAN/CSA Standard C22.2 No. 60529-05	Degrees of Protection Provided by Enclosures (IP Code)
UL Standard 508	Industrial Control Equipment
UL Standard 913	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations



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Master Contract: 237484

Project: 2386064

Date Issued: April 29, 2011

ANSI/ISA Standard 12.12.01-2007	Nonincendive Electrical Equipment for Use in Class I and II, Division 2, and Class III Divisions 1 and 2 Hazardous (Classified) Locations
UL Standard 60079-0	Electrical Apparatus for Explosive Gas Atmospheres – Part 0: General Requirements
UL Standard 60079-11	Electrical Apparatus for Explosive Gas Atmospheres Part 11: Intrinsic Safety "i"
UL Standard 60079-15	Electrical Apparatus for Explosive Gas Atmospheres Part 15: Electrical Apparatus with Type of Protection "n"
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)

MARKINGS

The following markings are provided on CSA-Accepted (Class 7922-01, File number 99316) adhesive label stock Product Number 7871 manufactured by 3M Company, which is suitable for indoor or outdoor use on Plastic Group VII, at a maximum service temperature of 80°C or higher. The label stock shall be printed with one of the approved printer and ink combinations as specified in the manufacturers listing and the finished label is affixed to the housing.

- Manufacturer's name, "Automation Products Group", or CSA Master Contract Number "237484", adjacent to the CSA Mark in lieu of Manufacturer's name.
- Model number: as specified in the PRODUCTS section, above.
- Electrical ratings: as specified in the PRODUCTS section, above.
- Ambient temperature rating: as specified in the PRODUCTS section, above (may be abbreviated).
- Manufacturing date in MMY format, or serial number, traceable to month of manufacture.
- The CSA Mark with "C" and "US" indicators, as shown on the Certificate of Conformity.
- Hazardous Location designation: as specified in the PRODUCTS section, above.
- Temperature Code: as specified in the PRODUCTS section, above (May appear on control drawing).
- Class I Division 1 additional Markings -
 - "Exia" followed by "IIB"
 - "INTRINSICALLY SAFE"
 - "WARNING- EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY" (Equivalent wording is acceptable).
 - "WARNING- TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTIBLE ATMOSPHERES, DISCONNECT POWER BEFORE SERVICING".
 - "Install per Drawing 9002748" (or equivalent): as specified in the PRODUCTS section, above
- Class I Division 2 additional Markings –
 - "Ex nA" followed by "IIB"
 - "WARNING- DO NOT DISCONNECT EQUIPMENT UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS".
 - "WARNING – POTENTIAL ELECTROSTATIC CHARGING HAZARD – SEE INSTRUCTIONS" (or equivalent).



Certificate: 1911747

Master Contract: 237484

Project: 2386064

Date Issued: April 29, 2011

-
- For the LPU Series Ultrasonic Sensors, the words “Reference installation drawing number 9002745” (or equivalent): as specified in the PRODUCTS section, above
 - For the LOE Series Ultrasonic Sensors, the words “Reference installation drawing number 9003469” (or equivalent): as specified in the PRODUCTS section, above
 - For the LOE Series Ultrasonic Sensors, the manual shall contain the following words: “WARNING – NONCONDUCTIVE SURFACE OF THE HOUSING MAY BE CHARGED BY NONCONDUCTIVE MEDIA, CLEAN WITH A DAMP CLOTH”

Note - Jurisdictions in Canada may require these markings to also be provided in French language. It is the responsibility of the manufacturer to provide bilingual marking, where applicable, in accordance with the requirements of the Provincial Regulatory Authorities. It is the responsibility of the manufacturer to determine this requirement and have bilingual wording added to the "Markings".



Automation Products Group, Inc.

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